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Division

Geology of the
Lavant Area
Frontenac and Lanark Counties

Ontario Geological Survey
Report 253

by Liba Pauk

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Foreword

Until 1982 the geological map coverage of the Lavant Area was at a reconnaissance level. The present detailed mapping of the area was designed to encourage exploration interest and to provide a mineral potential evaluation.

The bedrock of the Lavant Area hosts several metallic and nonmetallic mineral occurrences. Several small stratabound copper deposits in the area contain gold and silver and, in places, barite and minor mercury. Minor amounts of pyrrhotite and chalcopyrite occur in metasediments and metavolcanics.

A few scintillometer anomalies of 3 to 5 times background were noted over pegmatite sills that may indicate the presence of uranium.

Non-metallic deposits in the area consist of good quality dolomitic marble and of sand and gravel.

V.G. Milne
Director
Ontario Geological Survey

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GEOLOGICAL MAP (BACK POCKET)

MAP 2525 (coloured)-Lavant area, Lanark and Frontenac Counties.
Scale 1:31 680

CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

CONVERSION FROM SI TO IMPERIAL			CONVERSION FROM IMPERIAL TO SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ton (short)	1 ounce (troy)/ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ton (short)	1 pennyweight/ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE–Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in co-operation with the Coal Association of Canada.

Geology of the
Lavant Area
Lanark and Frontenac Counties

by
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Abstract

The Lavant area covers about 250 km^2 and is located some 85 km southwest of the City of Ottawa and 92 km north-northwest of the City of Kingston.

All the bedrock in the map area is of Late Precambrian age. The oldest rocks are metavolcanics and metasediments which are correlative with the Hermon and Mayo Groups (Lumber 1967) of the Grenville Supergroup. The volcanic rocks range in composition from basalt to andesite and the sedimentary succession is comprised of feldspathic and calcareous feldspathic sandstone, wacke, shale, calcareous mudstone, and carbonate rocks. Two narrow bands of the younger Flinton Group clastic metasediments are exposed in the northwest and west-central parts of the map area.

The older stratified lithologies were intruded by early tectonic to syntectonic felsic to mafic rocks. All of the stratified lithologies, including the Flinton Group, were subsequently intruded by the late tectonic intrusions of granitic composition. The early to syntectonic intrusive rocks were not found in contact with rocks of the Flinton Group. Their relative age relationship therefore is not known. The volcanic and the sedimentary rocks were metamorphosed into a variety of mafic to felsic gneisses, schists, and marbles.

A major north-southward trending fault zone, the Robertson Lake Shear Zone, transects the central part of the map area. The area west of this fault zone, occupied largely by stratified lithologies, shows intensive deformation dominated by northeastward trending isoclinal and large-scale folds. The area east of the shear zone is occupied by a large competent intrusive mass which is practically structureless.

There are several mineral occurrences in the area. Only one of them, an iron deposit, had been exploited in the past.

A barite-sulphide mineralization was discovered within the succession of carbonate metaclastic rocks in the northwestern part of the area in the late 1910s. Since that discovery considerable mineral exploration led to the successful delineation of a copper-silver-antimony-mercury deposit. More recently, mineral exploration was focused on occurrences of copper, antimony, mercury, silver, and gold hosted by carbonate rocks within the Robertson Lake Shear Zone. Potential exists for additional discoveries within this zone.

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Résumé

La région de Lavant, qui s'étend sur près de 250 km², est située à quelque 85 km au sud-ouest de la ville d'Ottawa et à 92 km au nord-nord-ouest de la ville de Kingston.

Toutes les roches de fond de la région illustrée sur la carte datent du précambrien supérieur. Les roches les plus anciennes sont métavolcaniques et métasédimentaires et sont corrélatives des groupes Hermon et Mayo (Lumbers 1967) du super-groupe de Grenville. Les roches volcaniques présentent des compositions variées, allant du basalt à l'andésite, et la succession sédimentaire est formée de grès feldspathique et feldspathique calcaire, wacke, schiste, argile calcaire et carbonate. Deux sillons étroits de roches métasédimentaires clastiques du groupe plus récent de Flinton apparaissent dans les régions nord-ouest et centre-ouest de la région illustrée sur cette carte.

Les lithologies stratifiées plus anciennes présentent des intrusions de roches tectoniques pré à syntectoniques felsiques et mafiques. Toutes les lithologies stratifiées, y compris le groupe Flinton, ont ensuite subi des intrusions de roches tectoniques supérieures de composition granitique. On n'a pas trouvé de roches intrusives pré à syntectoniques au contact des roches du groupe Flinton. On ignore donc leur rapport d'âge relatif. Les roches volcaniques et sédimentaires se sont métamorphosées en un certain nombre de gneisses mafiques à felsiques, schistes et marbres.

Une importante zone de faille d'orientation nord-sud, la zone de cisaillement du lac Robertson, sectionne transversalement la partie centrale de la région illustrée sur la carte. La région ouest de cette zone de faille, occupée principalement par des lithologies stratifiées, révèle une déformation sensible dominée par d'importants plis isoclinaux d'orientation nord-est. La région est de la zone de cisaillement est occupée par une grande masse intrusive et compétente qui n'a pratiquement pas de structure.

On note la présence de plusieurs gisements minérales dans la région. Une seule, un gisement de fer, a été exploitée dans le passé.

A la fin des années 1910, on a découvert une minéralisation de barytine-sulfure dans la succession de roches métaclastiques carbonatées dans la partie nord-ouest de la région. Depuis cette découverte, une exploration minière intensive a permis de délimiter avec succès un gisement de cuivre, argent, antimoine et mercure. Plus récemment, l'exploration minière s'est concentrée sur les formations de cuivre, antimoine, mercure, argent et or contenues dans les roches carbonatées de la zone de cisaillement de lac Robertson. Cette zone contient d'autres possibilités de découvertes.

Introduction

Location and Access

The map area covers approximately 250 km^2, lies in Lanark and Frontenac Counties, and is bounded by 45°00'N and 45°07'30"N Latitudes and 76°30'W and 76°45'W Longitudes. The centre of the area is located about 92 km southwest of the City of Ottawa and about 95 km north-northwest of the City of Kingston. The hamlet of Lavant at Robertson Lake is located near the central part of the map area.

The area lies east of Highway 509 and west of Highway 511 and is accessible by Lanark County Road No.16, a westward trending road in the central part of the map area. Township roads, forest access roads, lumber roads, and power line service roads provide good access to most of the map area. The abandoned Kingston and Pembroke Railway has been converted and maintained as a snowmobile trail and provides good access to the relatively remote northwestern part of the map area.

Field Work

Geological mapping of the Lavant area at a scale of 1 inch to 1/4 mile, or 1:15 840, was carried out by the author and her assistants during the summer of 1982. The field base maps were produced by the Cartography Unit, Ministry of Natural Resources from National Topographic Series provisional map 31 F/2. Mapping was carried out by pace-and-compass traverse lines approximately 400 to 600 m apart and at right angles to the strike of rock units. The geological data were plotted on acetate overlays fitted over 1:15 840 air photographs and then transferred to the base map of the same scale. Areas with old workings and known occurrences of metallic minerals were examined in detail.

Acknowledgments

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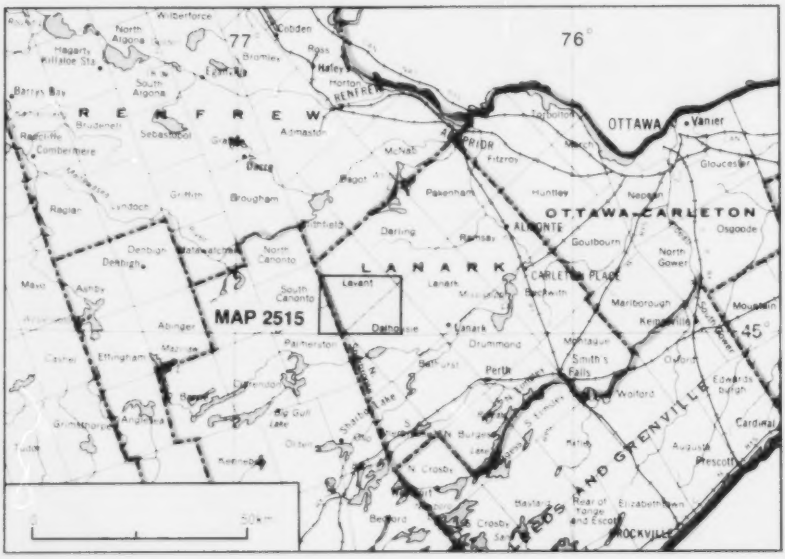

Figure 1. *Key map showing location of Lavant area.*

Previous Geological Work and Mineral Exploration

R.W. Ells (1904) examined some parts of the map area along the roads and along the Kingston-Pembroke Railway route as part of a Geological Survey of Canada mapping program south of the Ottawa River. He examined the section along the Kingston-Pembroke railway which crosses the western part of the map area partly across but mostly along strike. From the south to the north he described bands of marble, followed by red granite, and hornblende schist. He noted the appearance of coarse-grained silvery mica schist north of the settlement of Folger, which is followed by yet another band of marble. He reported the presence of great masses of non-foliated black hornblende diorite in a section from Robertson Lake, east to and south of, the settlement of Poland and a ridge of red massive to weakly foliated granite west of Robertson Lake. The presence of copper and small amounts of gold were reported from pyritiferous ore hosted by dolomitic marble in the north-central part of the map area. A sample of quartz from a location to the east of Spectacle Lake was reported to contain 0.195 oz/ton gold.

Systematic geological mapping of Lavant, Dalhousie, Palmerston, and a few adjacent townships was first carried out by B.L. Smith (1958) and P.A. Peach (1958) between 1948 and 1951 at a scale of 1 inch to 1 mile. Smith (1958) outlined the major lithological and structural units of the region. He described a zone of intense shearing along and to the north and south of Robertson Lake.

D.F. Hewitt (1956) includes the map area as part of the Kaladar-Dalhousie Trough.

In 1972, J.M. Moore Jr. and P.H. Thompson assign the succession of clastic metasediments, which overlies the older metavolcanics and metasediments, to the Flinton Group. They outline the stratigraphic succession and structure of the Fernleigh Syncline which is exposed southwest of the map area and lies on strike with a belt of the younger Flinton metasediments which is exposed in the northwestern part of the map area.

C.A. Nikols (1972) describes the geology of the Clyde Forks mercury-antimony-copper deposit and that of the surrounding area.

T. Rivers (1976) presents a detailed structural analyses of the Ompah area, which includes the western part of the map area.

T.R. Carter, A.C. Colvine, and H.D. Meyn (1980) describe base metal, precious metal, iron, and molybdenum deposits of the Pembroke-Renfrew area including the mineral deposits and occurrences within the present map area.

Moore and Thompson (1980) outline the complete stratigraphy and structure of the Flinton Group and present a model of the evolution of this unit.

Carter (1981) describes the Lavant-Darling metavolcanics and metasediments and the geology, mineralization, and genesis of the Lavant-Darling copper-antimony-gold-silver deposits.

The history of mineral exploration and production within the map area dates back to the 1880s and is closely related to the construction and opening of the Kingston and Pembroke Railway. The Wilbur Mine (10) (number following property represents locations on maps in back pocket) is one of several iron ore deposits which had been worked along this railway route in the last century. The mine was leased from the owner William Caldwell by the Kingston and Pembroke Mining Company. The ore was extracted from eight workings and shipment of 125,000 tons of high-grade ore was made (Ingall 1901). An unspecified number of diamond-drill holes had been drilled and a dip needle survey was conducted in the early years (Ingall 1901). After 1900, the mine was intermittently developed and operated by the owner, William Caldwell, Wilbur Mine Iron Ore Company (1907-1908), Hawthorne Silver and Iron Mines Company (1910), and Exploration Syndicate of America until its closing in 1911 (Lindeman and Bolton 1917; Corkill 1912).

A smaller occurrence of magnetite exposed in a shallow pit 1.3 km west of Lavant Station was reported by Ingall (1901).

In 1918 and 1919, T.B. Caldwell carried out surface stripping and test pitting on the barite occurrence of the Clyde Forks (2) property in the northwestern corner of the map area. On the bottom of the test pit, considerable sulphide mineralization had been discovered (Spence 1922). Small samples of barite analyzed by Mines Branch Ore Dressing Laboratories yielded 96.25 percent barium sulphate, 0.52 percent copper, 1.8 oz/ton silver, and showed the presence of antimony and arsenic (Spence 1922). Between 1957 and 1970 a comprehensive mineral exploration program of diamond-drilling, geochemical and geological surveys, surface stripping, and soil sampling was conducted on the property by Lanark Silver Mines Limited, West Branch Explorations and Mining Company Limited, and Carndesson Mines Limited. During the operations of the West Branch Exploration and Mining Company Limited, mercury mineralization was also discovered.

The presence of old trenches, test pits, and blasted outcrops within the Robertson Lake Shear Zone testifies to a long period of prospecting and exploration for gold and base metals within this geological structure. Thirteen trenches and pits are found on the site of the Robertson Gold Deposit (9). These surface works and about 1000 m of diamond drilling were performed by Consolidated Mining and Smelting Company in 1938 and 1944 (Smith 1958).

The search for Au and Cu-Sb-Au-Ag mineralization within the shear zone was intensified in a period between the late 1950s and late 1970s. In 1957, nine holes totalling 500 m were diamond drilled by H.F. Taylor on two claims in the Lavant Creek (5) area (Assessment Files Research Office, Ontario Geological Survey, Toronto). In 1973, J. Begin (1) of Ottawa sampled a bornite-chalcopyrite mineralization zone exposed by trenching at the Lavant waste disposal site (Source Mineral Deposit Records, Ontario Geological Survey, Toronto). In 1975, Lynx Canada Limited completed geological and geochemical surveys and rock sampling on 22 claims covering the areas of the Joes Lake Deposit (3), Lavant Deposit (4), Lavant Creek Deposit (5), Lynx-Canada Deposit (7), and Nelson Lakes Deposit (8). The Joes Lake Deposit had been subsequently investigated by a diamond-drilling program by Selco Mining Corporation Limited (under the Pharaoh option) in 1978. Further extent and results of the exploration activities within the map area are described in the "Economic Geology" section under "Description of Properties."

Physiography

The elevation above sea level in the map area ranges from about 215 to 335 m. Most of the area is rugged and a steady increase in relief to the north is apparent. The average relief is about 65 m in the northern parts of the region, but may reach 115 m. The west-central part of the map area is occupied by an east-northeastward striking prominent tectonic depression — the Robertson Lake Shear Zone. West of this shear zone, the topography is controlled by northeastward trending ridges and narrow valleys. East of the shear zone a large intrusion causes a rugged topography with high local relief. Rolling hills line the eastern border of the map area and are underlain by metavolcanics and carbonate metasediments. The streams and lakes in the northern half of the area drain northward to the Clyde Forks River which flows to the Mississippi River. The southern half of the area drains directly to the Mississipi River.

There is excellent bedrock exposure throughout most of the area with the exception of the southern part of the Robertson Lake Shear Zone, the areas along the eastern boundary, and along the ridge east of the southern branch of the Clyde Forks River. Some excellent exposures are present along the railway cut of the abandoned Kingston and Pembroke Railway and generally along most of the power line.

General Geology

INTRODUCTION

The Lavant area forms part of the Central Metasedimentary Belt (Wynne-Edwards 1972) of the Grenville Province, and lies within the Dalhousie-Kaladar Trough (Hewitt 1956). The study area was first mapped at a scale of 1:63 360 by Smith (1958) and Peach (1958). All of the bedrock is of Middle Proterozoic age.

Metavolcanics and metasediments underlie nearly one half of the map area. Syntectonic bodies of granite-gneiss and an extensive mafic intrusion underlie the central and eastern parts of the region respectively. The oldest stratified lithologies are comprised of metavolcanics and metasediments that can be correlated with the Hermon and Mayo Groups of the Grenville Supergroup defined by S.B. Lumbers (1967) in the Madoc-Bancroft area. Two narrow bands of clastic metasediments which are correlated by the author with the younger Flinton Group (Moore and Thompson 1972) are present in the northwestern and west-central parts of the region, respectively.

The supracrustal rocks have been folded into northeastward trending zones and are separated by plutonic bodies into three separate belts: the western, central (Lavant-Darling supracrustal succession), and eastern. The western supracrustal belt is characterized by the presence of nearly equal proportions of metavolcanics, clastic metasediments, and carbonate metasediments, whereas the central and eastern supracrustal belts are comprised predominantly of metavolcanics and carbonate metasediments.

The thickest supracrustal succession is exposed in the western part of the map area. It is comprised of mafic to intermediate metavolcanics (map units 1a, b, c), siliceous to calc-siliceous clastic metasediments (map unit 3), and carbonate metasediments (map unit 6). The bands containing abundant intercalations of metasediments, metavolcanics, and some metasediments which may be part of the younger Flinton Group have been included in map unit 5. The metavolcanics occur as arcuate-shaped structures, that are wrapped more or less symmetrically around the Cross Lake Antiform. Tectonic thickening of the metavolcanics is apparent northwest of and around the nose of the Cross Lake Antiform in the hinge. All of the metavolcanics in the western supracrustal belt are compositionally and texturally similar and therefore are believed by the author to belong to the same volcanic sequence.

Siliceous clastic metasediments, carbonate metasediments, and their intercalates and infolds are dominant in the Clyde Forks Antiform in the northwestern and in the Cross Lake Antiform in the southwestern parts of the map area. A narrow band of marble with subordinate clastic metasediments and metavolcanics borders the west side of the Addington Complex.

The central belt of supracrustal rocks (Lavant-Darling supracrustal succession, Carter 1981) is wedged in between the Addington Complex of granite- to quartz monzonite-gneiss to the west and the Lavant Gabbro Complex to the east. The rocks are comprised of dominantly mafic metavolcanics and intercalated carbonate metasediments with subordinate metamudstones (map unit 4) and siliceous clastic metasediments (map unit 3d). A large part of these rocks is contained within the Robertson Lake Shear Zone and their original composition and textural characteristics have been highly modified by shearing, fracturing, and retrograde alteration. Carbonate metasediments predominate in the eastern (upper) part of the Lavant-Darling supracrustal succession with light to dark grey aphanitic to fine-grained dolomitic marble being most abundant.

In the eastern part of the area, the supracrustal succession of metavolcanics, carbonate metasediments, and minor metaclastics form narrow bands, lenses, and inclusions within the Lavant Gabbro Complex. A sequence of fragmental tuffaceous and massive mafic metavolcanics (map units 1f,g,h) have been documented in this region. Submarine volcanism is demonstrated by the presence of highly deformed yet identifiable pillow basalt (map unit 1k). White to light grey, medium-grained, calcitic marble and banded calcitic marble are by far the most abundant of the carbonate metasediments in this region.

TABLE 1. TABLE OF LITHOLOGIC UNITS FOR THE LAVANT AREA.

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Till, gravel, sand, and organic deposits.

Unconformity

PRECAMBRIAN

MIDDLE PROTEROZOIC[a]

LATE TECTONIC FELSIC INTRUSIVE ROCKS[b]

Pegmatite[c], granite, and granite-gneiss

Intrusive Contact

FLINTON GROUP[b,c]

FERNLEIGH FORMATION

Biotite-diopside ± carbonate ± hornblende schist; hornblende-biotite-carbonate ± diopside schist.

MYER CAVE FORMATION

Calcitic marble, dolomitic marble and interlayered biotite schist; fine-grained graphite ± pyrite schist.

BISHOP CORNERS FORMATION

Medium- to coarse-grained pelitic schist; muscovite-quartz schist; muscovite-biotite-quartz schist; biotite-quartz schist; locally with garnet, sillimanite, porphyroblasts of oligoclase and iron oxide; light to dark grey, fine-grained biotite ± muscovite ± pyrite metasandstone; white to light grey, fine-grained muscovite ± pyrite metasandstone; locally rusty biotite-pyrite gneiss and metasandstone; interlayers of fine-grained, biotite and fine-grained, rusty, biotite schist; fine-grained plagioclase-biotite-quartz ± garnet ± muscovite schist; locally rusty, quartz-biotite schist; medium-grained, pinkish grey, biotite-plagioclase ± K-feldspar schist with porphyroblasts of muscovite; fine-grained, light grey-pink, laminated muscovite-quartz-plagioclase-K-feldspar ± biotite gneiss and metasandstone; medium- to fine-grained, pink, plagioclase-quartz-carbonate ± biotite gneiss with porphyroblasts of muscovite; light to dark grey, fine- to medium-grained, laminated hornblende-biotite-plagioclase-quartz ± epidote ± carbonate gneiss and schist; dark green-grey, medium- to fine-grained, biotite-hornblende-plagioclase ± quartz ± carbonate ± epidote ± microcline ± scapolite gneiss and schist; quartzite-pebble metaconglomerate

TABLE 1. CONTINUED.

Unconformity

SYNTECTONIC MAFIC INTRUSIVE ROCKS[b]

LAVANT GABBRO COMPLEX

Minor granite-pegmatite and aplite veins and dikes; fine-, medium- to coarse-grained white to light grey granodiorite and quartz diorite; fine-, medium- to coarse-grained diorite and gabbro-diorite; fine-, medium-, coarse- to very coarse-grained gabbro; locally diabasic texture; locally coarse-grained segregations of hornblende; dark green to black, medium- to coarse-grained pyroxene gabbro; locally porphyritic gabbro with phenocrysts of pyroxene or hornblende; sheared phases of the complex.

METAMORPHOSED FELSIC INTRUSIVE ROCKS[b]

ADDINGTON COMPLEX

Medium- to fine-grained, pink, lineated to weakly foliated biotite ± muscovite granite-gneiss; medium-grained, foliated, pink, biotite ± hornblende granite-, quartz monzonite-, and granodiorite-gneiss; fine-grained, well-foliated, pink, biotite ± muscovite quartz monzonite- and granodiorite-gneiss; banded migmatite; fine-grained, pink, contaminated granite-, quartz monzonite-, and granodiorite-gneiss; sheared phases of the above units

GRANODIORITE-GNEISS AND TRONDHJEMITE-GNEISS

Medium-grained, medium grey, foliated biotite ± hornblende trondhjemite-gneiss of the Northbrook Batholith; white, medium- to fine-grained, weakly foliated biotite granodiorite-gneiss of the Northbrook Batholith; medium-grained, light grey, biotite ± hornblende trondhjemite-gneiss forming layers within the Addington Complex

Intrusive Contact

GRENVILLE SUPERGROUP (HERMAN AND MAYO GROUPS)

METASEDIMENTS[b] AND METAVOLCANICS[b]

CARBONATE METASEDIMENTS

Medium- to coarse-grained, white and grey banded calcitic marble; locally salmon pink, calcitic marble; creamy, light to dark grey, fine-grained dolomitic marble; fine-grained silty dolomitic marble; locally laminated, fine-grained dolomitic marble; fine-, medium- to coarse-grained calcitic and dolomitic marble contaminated with phlogopite, diopside, tremolite, biotite, hornblende; calcitic and dolomitic marble with quartzite and cherty layers and lenses; tremolite reaction rims commonly present at quartzite-marble interphases; carbonate, diopside ± phlogopite ± biotite banded gneiss; white and grey, medium- to coarse-grained dolomitic marble; coarse-grained, diopside-calcite ± tremolite ± epidote ± quartz ± garnet schist and skarn; magnetite-calcite ± diopside skarn; sheared phases of the above units

TABLE 1. CONTINUED.

FELSIC TO MAFIC GNEISS AND SCHIST (METAVOLCANICS AND METASEDIMENTS)[d,e]

Fine- to medium-grained, dark green to black, hornblende-plagioclase ± biotite± carbonate gneiss and schist; fine- to medium-grained, in places laminated, dark grey, biotite-quartz-plagioclase ± hornblende ± carbonate ± epidote gneiss and schist; fine- to medium-grained, medium to light grey, biotite-plagioclase-quartz ± muscovite ± hornblende ± garnet gneiss and schist; fine- to medium-grained, grey and pinkish grey, biotite-muscovite±microcline-plagioclase-quartz gneiss and schist; locally porphyroblasts of muscovite; fine-grained muscovite-biotite metasandstone; locally rusty metasandstone; mediumto fine-grained muscovite schist; medium- to fine-grained biotite-muscovite schist; fine- to medium-grained, pink, muscovite-quartz-feldspar, ± carbonate gneiss; fine-grained biotite-diopside schist; fine-grained hornblende ± biotite-carbonate schist

CLASTIC METASEDIMENTS

LIMY METAMUDSTONES

Dark grey, very fine grained biotite-calcite schist (metamudstone); fine-grained, laminated biotite-calcite ± hornblende schist; the above rock types sheared and fractured (in the Robertson Lake Shear Zone)

SILICEOUS, CALC-SILICEOUS, AND PELITIC CLASTIC METASEDIMENTS[c]

Light to medium grey, fine- to medium-grained biotite and muscovite-biotite-quartz-plagioclase ± garnet ± microcline gneiss; white to light grey, fine-grained biotite-quartz-muscovite ± metasandstone; fine-grained, white, muscovite-plagioclase metasandstone; locally containing hornblende and epidote; locally rusty pyritic plagioclase metasandstone; fine-, medium- to coarse-grained, biotite-plagioclase-quartz schist locally containing hornblende; fine-grained, white, light grey to dark grey, muscovite and biotite ± muscovite quartzite; fine- to medium-grained, dark grey metawacke, calcareous metawacke, and pyritic metawacke; medium- to fine-grained hornblende-plagioclase ± biotite ± quartz ± carbonate gneiss and schist; medium-grained to coarse-grained muscovite and biotite-muscovite-quartz ± plagioclase ± microcline schist, locally with garnet, sillimanite; diopside-quartz-plagioclase ± biotite ± hornblende ± carbonate gneiss and metasandstone; fine-grained, pink, laminated, biotite ± muscovite±microcline-plagioclase-quartz gneiss; fine-grained, pink, muscovite-microcline-plagioclase metasandstone; white to light grey, foliated to laminated medium- to coarse-grained plagioclase-quartz ± biotite ± epidote ± hornblende ± tremolite ± carbonate ± diopside gneiss; sheared phases of the above units

FELSIC TO MAFIC GNEISS OF VOLCANIC AND SEDIMENTARY ORIGIN[c,f]

Medium-grained, hornblende-plagioclase ± biotite ± quartz gneiss; fine- to medium-grained, light grey biotite-plagioclase-quartz ± hornblende gneiss; sheared phases of the above units

TABLE 1. CONTINUED.

MAFIC TO INTERMEDIATE METAVOLCANICS[d]	Dark greyish green, fine- to medium-grained hornblende-plagioclase ± biotite ± garnet gneiss; medium greenish grey, fine- to medium-grained biotite-hornblende-plagioclase ± quartz gneiss; fine- to medium-grained, laminated gneiss; dark greyish green hornblende-biotite-rich laminae alternate with light grey feldspathic and quartzofeldspathic laminae; massive to weakly foliated, aphanitic to medium-grained, dark green to dark greenish grey, chlorite-actinolite-hornblende mafic and intermediate melavolcanics; commonly fractured, sheared, pyritized, carbonatized, and silicified; dark green, aphanitic chlorite schist; mafic gneiss and schist of pyroclastic origin; dark green to black, hornblende-rich relic fragments up to 12 cm in length set in a fine-grained, dark grey matrix of hornblende-biotite-plagioclase; fine-grained to aphanitic, dark grey to black, hornblende-plagioclase ± biotite gneiss; mafic to intermediate tuff; fine- to medium-grained, hornblende-plagioclase ± biotite schist with relic pillow structures, fine-grained, dark green to black, hornblende-plagioclase ± biotite schist with relic variolitic texture; sheared phases of the above units

NOTES:
a) All rock units, with the possible exception of some late tectonic felsic intrusive rocks have undergone middle to high grade metamorphism and deformation with complete recrystallization. Primary lithologic names are used where identification is reasonably certain.
b) Order does not imply age relationships.
c) Pegmatites are of various ages.
d) Metamorphic terminology is used in naming these rocks with the least abundant mineral placed first.
e) This unit comprises rocks of volcanic origin and rocks of sedimentary origin possibly including Flinton Group rocks.
f) This unit forms narrow lenses and layers within the Addington Complex. Relationship to the unit "Felsic to Mafic Gneiss and Schist (Metavolcanics and Metasediments)" is not known.

The supracrustal assemblages have been intruded by a variety of syntectonic to late tectonic intrusive rocks.

A narrow conformable band of light grey to white biotite granodiorite- and biotite trondhjemite-gneiss (map unit 7a,b) that has intruded the supracrustal rocks southwest of Caldwell Lake is considered by the author to represent the northeastern limits of the Northbrook Batholith (Pauk 1984).

The Addington Complex (Lavant Gneiss of Smith 1958) comprising gneiss of granite and quartz monzonite crosses the west-central part of the area in an approximately 2 km wide north-northeastward trending zone. The complex encloses narrow conformable layers and lenses of marble (unit 6) and clastic metasediments and metavolcanics (map unit 2). A 500 to 700 m wide layer of supracrustal rocks is enclosed by the Addington Complex northwest of Robertson Lake. The Addington Complex also forms numerous narrow (1 to 200 m) layers within the western and less commonly in the central supracrustal belts. The textural and compositional characteristics of the Addington Complex and its field relations with the supracrustal rocks suggest that it might have originated by granitization of pre-existing lithologies.

The body occupying the core of the Cross Lake Antiform is comprised of fine- to medium-grained, lineated to weakly foliated, pink, biotite ± muscovite granite-gneiss. Along its southern contact, granite-gneiss grades laterally into light grey,

fine-grained, biotite gneiss and metasandstone. These rocks show similar compositional characteristic and field relations with the supracrustal rocks as does the Addington Complex hence they have been grouped in map unit 8. The term, Addington Complex-Graham Lake facies, will be used to identify the above small body.

The Lavant Gabbro Complex (map unit 9) occupies a prominent topographic high in the eastern half of the map area. The body, generally conformable with supracrustal rocks, extends further to the southwest and to the northeast for a total length of about 40 km. Throughout the map area, the intrusion varies in composition and in texture, comprising fine-, medium- to coarse-grained gabbro, diorite, and granodiorite. The common presence of crosscutting patches and dikelets of several textural and compositional varieties within a single outcrop suggests that several subsequent intrusive stages are responsible for the heterogenity of the complex. Only the northwestern and northern parts of the body comprised of fine-, medium- to coarse-grained pyroxenite gabbro are compositionally more homogeneous. Primary rhythmic and graded layering of pyroxene cumulus was observed in a roadcut 1200 m northwest of Black Creek Meadow. The Lavant Gabbro Complex in general is structureless except for its peripheral parts which in places exhibit weak foliations. Parts of its western border zone have also been affected by shearing and fracturing in the proximity of the Robertson Lake Shear Zone.

The Lavant Gabbro Complex encloses numerous roof pendants and septa of supracrustal rocks particularly along its eastern border.

A narrow band of intercalated pelitic, psammitic, calc-pelitic and carbonate metasediments of the Flinton Group conformably overlies the older metasediments and metavolcanics in the northwestern part of the area. This band lies on the northeastward strike extension of the Fernleigh Syncline which contains the Flinton Group sedimentary rocks, and is well documented about 10 km southwest of the present map area (Pauk 1982; Moore and Thompson 1972).

An isolated narrow band comprised of coarse-grained pelitic schist, rusty biotite metasandstone, and minor carbonate and calc-pelitic metasediments exposed west of Robertson Lake is considered by the author to be part of the Flinton Group as well.

Late stage felsic intrusive phases are represented by small granitic bodies (map unit 13), granite aplite and pegmatite dikes and veins intrusive into the Lavant Gabbro Complex and by numerous pegmatite dikes and sills that intrude the Addington Complex, Northbrook Batholith, and supracrustal rocks throughout the map area.

PRECAMBRIAN–MIDDLE PROTEROZOIC

GRENVILLE SUPERGROUP

The Middle Proterozoic metasediments and metavolcanics form part of the Hermon and Mayo Groups of the Grenville Supergroup. A stratigraphic assignment of these strongly deformed and metamorphosed rocks to specific formations was not possible during the present investigations. The following order of description therefore does not imply a stratigraphic order.

Mafic to Intermediate Metavolcanics

Metavolcanics form a substantial part of three separate northeastward trending supracrustal belts which underlie the western, central, and eastern parts of the region.

From the west to the east the metavolcanics vary in mineral composition, texture, and structure owing to different styles of deformation and different degrees of metamorphism as well as different original composition. A large predominant part of the Joes Lake metavolcanics (Carter 1981) which form part of the Lavant-Darling supracrustal succession (central supracrustal belt) is contained within the Robertson Lake Shear Zone. These rocks were affected by shearing, fracturing, and secondary alterations. A lithological correlation with the metavolcanics of the

western and eastern supracrustal belts therefore is not possible. Consequently, the metavolcanics are subdivided into a number of subunits. Subunits 1a, b, c are characteristic of the western; 1d and 1e are characteristic of the central, and subunits 1f, g, h, k, m are representative of the eastern supracrustal belt.

Western Belt of Supracrustal Rocks In the western belt of supracrustal rocks the metavolcanics are folded into an arcuate-shaped structure which envelops the Cross Lake Antiform. They also occur along the northwestern side of the Cross Lake Antiform. A narrow layer of metavolcanics is interlayered with metasediments east of Antoine Lake and also northwest of Robertson Lake.

The minimum thickness of the metavolcanics is approximately 350 m. Tectonic thickening is apparent in the vicinity of the settlement of Lavant Station, in the northwestern part of the arch, and around the nose of the Cross Lake Antiform.

In the western belt of supracrustal rocks the volcanic rocks were subjected to upper almandine-amphibolite facies metamorphism and transformed into a variety of dark green to medium green-grey gneiss and schist. Their original textural, structural, and compositional characteristics were completely obliterated. Consequently, the classification of the metavolcanics is based primarily on the colour index which ranges from 60 to 25. The classification of the metavolcanics into mafic and intermediate types is based on this index.

In this report gneisses are considered metamorphosed rocks of sedimentary or igneous origin, that possess linear, planar, or planar-linear structures caused by the alternation of layers, streaks, or lenticles of contrasting mineralogical composition and/or texture. One type of band, layer, or streak consists mainly of equidimensional quartz and feldspar grains with or without minor mafic minerals whereas the other type contains mafic minerals such as biotite and hornblende in varying amounts and also commonly felsic minerals. The term schist is applied to rocks of dominantly pelitic or calc-silicate composition that are rich in platy and/or lamellar minerals in parallel to subparallel orientation and that possess well-developed parallel cleavage. Granular minerals such as quartz, feldspar, and garnet are common and some degree of layering may be present.

Mafic metavolcanics are comprised of medium- to fine-grained, dark green hornblende, plagioclase gneiss and schist (map unit 1a). In thin section, the gneiss consists essentially of granoblastic plagioclase and subidioblastic hornblende. Less than 10 percent of diopside, cummingtonite, or biotite accompany hornblende in some of the rocks. Plagioclase (An_{35-65}) is commonly untwinned to poorly twinned preferentially according to the pericline twin law. The proportion of plagioclase to the mafic minerals is approximately 50:50. Common accessory minerals are magnetite, sphene, quartz, and apatite and in some rocks also pyrite and/or pyrrhotite. In one of the thin sections studied, small glomeroporphyroblasts of sphene accounting for nearly 10 percent of the rock were observed. Such excess of sphene is indicative of an alkaline affinity of the original basalt. In general, all of the mafic gneiss and schist display a homeoblastic fabric with straight to slightly curved grain boundaries that are indicative of subsolidus equilibrium conditions. Foliation is defined by preferred orientation of prismatic hornblende, by biotite, and by the segregation of mafic and felsic phases.

The intermediate metavolcanics comprise medium grey-green, medium- to fine-grained biotite-hornblende-plagioclase gneiss. The grain sizes of the rocks vary from 0.30 to 1.50 mm. The intermediate metavolcanics contain quartz (5 to 15 percent) and biotite (1 to 15 percent), and plagioclase (An_{30-35}) is more sodic than that of the mafic metavolcanics. Magnetite and apatite are common accessories. In one thin section, colourless cummingtonite was identified as an essential mafic mineral accompanied by only small amounts of hornblende and biotite. The rocks (map unit 1b) are foliated and the foliation is defined by segregated bands and lenses of mafic and felsic phases and by the orientation of mafic minerals.

Laminated gneiss of map unit 1c is characterized by strong subparallel segregations of alternate layers of mafic and felsic gneisses. Mafic laminae in the banded gneiss (map unit 1c), are composed principally of hornblende or hornblende and biotite; felsic laminae are comprised principally of plagioclase or

plagioclase-quartz. In some of the rocks, carbonate occurs in the quartzofeldspathic bands. Laminated gneiss varies in composition from mafic to intermediate. The banding of these rocks may indicate that they were formed from primarily stratified parent rocks, such as tuff or volcanogenic sediments.

High-grade metamorphism and the distribution of map units 1a, b, and c within the succession of the metavolcanics does not allow the identification of primary volcanic textures or the identification of individual flows.

Central Belt of Supracrustal Rocks The Lavant-Darling succession of supracrustal rocks comprises a thick sequence of mafic to intermediate metavolcanics. These metavolcanics are interlayered with narrow layers of carbonate and less commonly clastic metasediments. The abundance and thickness of the sedimentary intercalations increase towards the east, that is upward in the succession (Carter 1981).

The supracrustal succession strikes approximately north-south and dips 25 to 50 degrees to the east. With the exception of a narrow zone along the northwestern border all of the metavolcanics are contained within the north-southward trending Robertson Lake Shear Zone and exhibit strong shearing and fracturing which is accompanied by retrograde mineral alterations. Over the width and length of the shear zone, the intensity of deformation varies and the deformed metavolcanics can be classified as protomylonite, mylonite, and ultramylonite. These mylonites are green to dark green, fine-grained to very fine-grained chlorite schists. Dark green, more massive metavolcanics also occur in the shear zone. Comparatively little deformed rock is preserved in the centres of thick layers of metavolcanics. In the north-central part of the map area, chlorite schist and metavolcanics grade westward across a narrow zone of little deformed rocks into hornblende-plagioclase and biotite-quartz-hornblende-plagioclase gneiss (map unit 1a, b). Based on field characteristics the metavolcanics within the Robertson Lake Shear Zone are subdivided into relatively weakly foliated mafic and intermediate metavolcanics (map unit 1d) and strongly foliated and schistose chlorite schist (map unit 1e).

The most widespread of these two map units is unit 1d. The rocks in it are commonly fractured, sheared, carbonatized, pyritized, and silicified. On weathered surface, they exhibit a rugged texture which can be attributed to preferential weathering along networks of fractures and carbonate-filled fractures. Another explanation for the rugged weathered rock surfaces was forwarded by Carter (1981) who describes the rocks as "rubbly metavolcanics" and attributes the rugged texture to dissolution of carbonate inclusions within the metavolcanics.

In thin section, mafic and intermediate metavolcanics consist of very fine grained (0.1 mm and less) quartz, albite, carbonate, little epidote, and flakes of chlorite. The megascopically fairly massive rock possesses a strong microscopic L-S fabric defined by the orientation of almost all rock-forming minerals and by a very fine segregation lamination. The individual laminae comprise granoblastic quartz, carbonate, chlorite-carbonate-plagioclase, and epidote-carbonate-plagioclase. Only a few porphyroclasts of strongly strained quartz are preserved in the rock. Common accessory minerals are sphene, apatite, and opaque minerals. The strongly fractured metavolcanics may also reveal a fine granular mosaic of quartz and porphyroclasts of albite set in a dense matrix of chlorite and minor carbonate. Along shear planes and fractures the metavolcanics commonly contain pyrite. Coarse-grained aggregates of strongly strained quartz and carbonate may also be found along fractures. The width of the fractures varies from millimetres to several centimetres. According to R.H. Sibson's classification of fault rocks (1977), most of the rocks within map unit 1d can be classed as protomylomylonite to mylonite, whereas the chloritic schist of map unit 1e, discussed below, falls into the category of ultramylonite.

Map unit 1e comprises fine-grained to aphanitic, dark to medium green chloritic schist. These rocks are less abundant than map unit 1d and commonly form narrow lensoid layers within mafic and intermediate metavolcanics and marble.

Map unit 1p identifies sheared and fractured metavolcanics. In addition to mineral assemblages identified by the author, i.e. albite-chlorite-calcite and albite-

Photo 1. *Strongly fractured and sheared mafic metavolcanics of the Lavant-Darling supracrustal succession contained in the Robertson Lake Shear Zone. Approximately 250 m south of the northern boundary of map area.*

chlorite-epidote-calcite, the assemblages albite-chlorite-actinolite and albite-hornblende-chlorite were described by Carter (1981) in rocks of the present area. All of the metavolcanics contained within the Robertson Lake Shear Zone exhibit mineral assemblages diagnostic of the lower to upper greenschist facies. The rock textures are considered by the author to be products of retrograde metamorphism and accompanying cataclastic deformation. Carter (1981) considers the textures of the metavolcanics to be primary textures altered by progressive metamorphism.

Carter (1981) classifies the metavolcanics of the central belt of supracrustal rocks as calc-alkaline with the individual members of the suite showing chemical affinities to tholeiitic basalt and andesite and calc-alkaline basalt. He cautioned that the results may not be valid due to the close association of metavolcanics and marble. Carter (1981) noted an enrichment of Co, Cr, Ni, and Zn in the metavolcanics. He demonstrates that there is a large variation in trace element content among the various metavolcanics. According to him, this variation might have been caused by varying degrees of alteration, by the assimilation of marble inclusions, or may reflect the original composition of the rocks.

Eastern Belt of Supracrustal Rocks In the eastern part of the map area, only mafic metavolcanics occur (colour index >45). They form a small part of a thick succession of predominantly carbonate metasediments which extends northeastward along the eastern border zone of the Lavant Gabbro Complex (beyond the eastern boundary of the map area). Within the map area, metavolcanics and metasediments form small and large inclusions and subparallel layers and lenses within the Lavant Gabbro Complex. Outcrops of these layers and lenses commonly show that the Lavant gabbro has intruded the metavolcanics. This suggests to the author that the layers and lenses of metavolcanics probably are large roof pendants in the Lavant Gabbro Complex. In spite of being intruded and segmented by gabbro the metavolcanics of the eastern supracrustal belt generally exhibit lower degrees of deformation and metamorphic differentiation and their original structures and textures are partly preserved.

Photo 2. *Deformed fragmental metavolcanics, map unit 1f, exposed in power line clearing approximately 1700 m northeast of Village of Lammermoor and 1250 m southwest of eastern boundary of map area.*

During the present mapping, a succession of massive, fragmental, and tuffaceous metavolcanics of predominantly mafic composition was documented in this region. Massive mafic metavolcanics (map unit 1g) are dark greenish to black, fine grained and schistose. Their textures and mineral compositions are fairly uniform throughout the eastern belt of supracrustal rocks. In thin section, the massive mafic metavolcanics consist of small (0.1 to 0.2 mm) granoblastic plagioclase and small laths of dark brown-green strongly pleochroic hornblende ranging in size from 0.3 to 0.7 mm. Plagioclase makes up an estimated 30 percent and hornblende 70 percent of the rock. The rocks exhibit a linear fabric but lack penetrative foliation.

Fragmental metavolcanics (map unit 1f) are comprised of dark greenish black lens-shaped to irregularly shaped fragments set in a greenish grey fine-grained, somewhat schistose matrix. The fragments range in size from 1 to 6 cm in length and from 0.5 to 3 cm in width and make up from 20 to 70 percent of the rock. They are stretched and their long axes are oriented subparallel to each other and to the foliation of the matrix. In many outcrops and particularly those which are intruded by the Lavant Gabbro Complex, the fragments are strongly deformed and hardly recognizable within the matrix. In thin section, fragments are of almost ultramafic composition consisting of 80 percent dark green, strongly pleochroic hornblende, 15 percent magnetite, and 5 percent plagioclase. They exhibit a fine-grained (0.15 to 0.5 mm) schistose fabric. The greenish grey, fine-grained (0.20 to 0.40 mm) matrix is more felsic consisting of 60 percent plagioclase, 30 percent hornblende, and 10 percent biotite. Common accessory minerals are apatite and magnetite.

Fragmental metavolcanics containing smaller fragments, i.e. fragments smaller than 3 cm across, were mapped as tuffaceous metavolcanics (map unit 1h). Composition of both fragments and matrix is identical to the above-described fragmental metavolcanics.

Dark greenish black, hornblende-plagioclase semischists containing strongly deformed relict pillow structures (map unit 1k) are present in an outcrop in a roadcut 4.2 km east-southeast of the village of Poland and in two outcrops 1.7 and 2.3 km northeast of the village of Lammermoor. In thin section, the pillows are comprised of relatively coarse-grained (up to 2 cm) epidote and small granoblastic scapolite. Map unit 1 m comprises mafic semischists which exhibit relict variolitic texture. Relict varioles are present in the form of round to ovoidal to irregularly shaped, white spots of 0.50 to 5 mm in diameter. In thin section, the varioles consist of a very fine grained (0.15 mm) mosaic of plagioclase and small (0.08 mm) granules of diopside. The amount of diopside within individual varioles varies from trace to 25 percent. Few varioles are composed of relatively coarse-grained (0.75 mm) plagioclase. The varioles are set in a fine-grained (0.10 to 0.35 mm), weakly schistose matrix of hornblende, diopside, and magnetite.

Felsic to Mafic Gneiss of Volcanic and Sedimentary Origin

Map unit 2 represents gneiss and schist of both volcanic and metasedimentary origin. They form concordant layers and lenses ranging from 0.50 to 200 m in width within the Addington Complex. Both metavolcanics and metasediments are interlayered on a small scale, hence, their further division into separate metavolcanic and metasedimentary gneisses would be impractical with respect to the map scale. A variety of mafic and felsic gneiss and schist which are grouped in this unit strongly resemble the metavolcanics and metasediments of the neighbouring belts of supracrustal rocks. The contacts of the metavolcanics and particularly metasediments with the Addington Complex are gradational across narrow zones. At these contacts the metavolcanics and metasediments are enriched in potassium. Some sharp contacts with no apparent alteration of the enclosed lithologies are encountered, especially where the enclosed rocks are of mafic composition. The variation in character of the contact zones is likely due to a difference in susceptibility of various rock compositions and textures to metasomatic alteration. In general, siliceous clastic metasediments exhibit more gradational contacts than metavolcanics.

Map unit 2a includes gneissic, medium-grained, dark green to greyish green hornblende, plagioclase, and quartz, biotite, hornblende, plagioclase-bearing mafic to intermediate metavolcanics. Light to medium grey, fine- to medium-grained biotite-quartz-plagioclase±hornblende gneisses (map unit 2b) are considered to be equivalents of clastic metasediments. Along the eastern side of the pond at Umpherston Meadow, a 1 m thick layer of coarse-grained white muscovite schist is enclosed within the Addington Complex. Metasediments and metavolcanics enclosed within the Addington Complex are generally somewhat coarser than their counterparts exposed in the belts of supracrustal rocks.

Clastic Metasediments

Clastic metasediments are subdivided on the basis of mineral composition into the composite group of siliceous, calc-siliceous, and pelitic clastic metasediments (map unit 3) and calc-pelitic metasediments (limy, metamudstones, map unit 4).

The siliceous, calc-siliceous, and pelitic clastic metasediments form extensive layers in the western belt of supracrustal rocks. In the central and eastern belts, they are limited to a few narrow layers within a predominantly carbonate-metavolcanic succession. The limy metamudstones have limited exposure in the central and eastern belts of supracrustal rocks and are practically absent in the western belt.

Siliceous, Calc-Siliceous, and Pelitic Clastic Metasediments The siliceous and calc-siliceous clastic metasediments occur in the core and on the limbs of the Cross Lake Antiform and on the southern limb and on the hinge of the Clyde Forks Antiform in the southwestern and northwestern parts of the map area. Pelitic metasediments are confined to a few narrow bands in the southwestern part of the region. The original sediments were comprised of poorly to well-sorted feldspathic sandstone and siltstone, calcareous feldspathic sandstone, wacke, calcareous wacke, and subordinate quartz-rich sandstone and shale. The original sedimentary sequence was deformed and metamorphosed under almandine-amphibolite facies conditions to form metasandstone, quartzofeldspathic gneiss, a variety of mafic and calc-siliceous gneiss, and pelitic schist. The term "metasandstone" is used to describe non-gneissic rocks. Quartzofeldspathic gneisses are gneissic metasandstones. The siliceous clastic metasediments are commonly intercalated with each other and also with carbonate metasediments. The intercalations are in part sedimentary and in part deformational in origin.

White to light grey, fine- to medium-grained biotite and biotite-muscovite-quartz-feldspar gneisses (map unit 3a) are commonly interlayered with or grade into fine- and coarse-grained rocks of the same mineralogy. They are also interlayered with fine-grained metasandstone (map unit 3b) and coarser grained quartzofeldspathic gneiss (map unit 3k) and together all are dominant lithologies in the core of the Cross Lake Antiform. Biotite and muscovite-biotite-quartz-feldspar gneisses (map unit 3a) are fine to medium grained (0.5 to 1.5 mm), well-foliated, and comprised of quartz (25 to 30 percent), plagioclase (30 to 50 percent), biotite (5 to 15 percent), and muscovite (5 to 20 percent). Common accessory minerals are garnet, zircon, apatite, and opaque minerals. Some of the rocks contain up to 10 percent microcline. The gneiss displays more or less equigranular granoblastic to lepidoblastic texture. Foliation is well defined by subparallel orientation of flakes of muscovite and biotite and by a compositional layering of mica-poor bands and bands richer in micas.

White to light grey, fine-grained, muscovite, and biotite±muscovite metasandstone (map unit 3b) differs from map unit 3a by a finer grained fabric, weaker foliation, and smaller percentage of micaceous minerals. In thin section, the metasandstone is comprised of fine granoblastic quartz, plagioclase, little or no microcline, and 3 to 15 percent mica. Minor phases are apatite, tourmaline, and rutile. These rocks are megascopically fairly massive. In some areas underlain by metasediments, particularly in the southwestern part of the map area, rusty metasandstone containing up to 8 percent fine-grained pyrite is present. Where interlayered with the hornblende-plagioclase gneiss, the metasandstone may contain hornblende and epidote at the expense of muscovite and biotite.

Biotite schist (map unit 3c) is fine to medium grained and comprised essentially of quartz, plagioclase, and up to 50 percent biotite. Small amounts of hornblende may accompany biotite in some of these rocks. The schist forms narrow layers within the siliceous clastic metasediments and is commonly interlayered with biotite-hornblende-plagioclase gneiss (map unit 3f).

Map unit 3d represents well-sorted fine-grained (<1 mm) quartzite. These rocks are comprised essentially of granoblastic quartz and subordinate amounts of plagioclase, biotite, and/or muscovite. The quartzite is white, off-white to grey and displays a massive texture in the field. The presence of biotite accounts for a darker colour in some of these rocks. White quartzite forms narrow discontinuous layers within marble and metavolcanics in the Lavant-Darling supracrustal succession and is practically the only clastic metasediment present in this region. Quartzite interlayered with marble is calcareous. Very few outcrops of quartzite are present in the western belt of supracrustal rocks.

Metawacke (map unit 3e) forms a substantial part of the metaclastic succession on the southern limb of the Clyde Forks Antiform. The rocks weather grey, dark grey, greyish green to rusty and display fine- to medium-grained texture. They are characterized by a wide range of compositions, a heteroblastic fabric, and a lack of megascopically observable foliation. Estimated modal composition of four thin sections of samples of metawacke is presented in Table 2. In thin section, the

TABLE 2. ESTIMATED MODAL COMPOSITION (IN PERCENT) OF METAWACKE (MAP UNIT 3e).

Sample No.	L-593-82	L-590-83	L-595-82	L-574-82
Plagioclase	35	35	65	42
Quartz	10	20	5	35
Hornblende	5	37	15	-
Cummingtonite	-	-	6	-
Biotite	15	3	1	16
Muscovite	-	-	-	3
Chlorite	10	-	-	4
Opaque minerals	10	<1	7	-
Apatite	trace	-	-	trace
Sphene	-	trace	-	trace
Calcite	15	5	-	-

metawacke displays weak to moderate foliations marked by layers and lenses of differing mineral compositions and textures and by the preferred orientation of some of the prismatic grains of hornblende and mica.

Map unit 3f incorporates hornblende and biotite-hornblende-plagioclase gneiss and schist which may have originated from muddy calcarenites. Compositionally they are similar to the mafic to intermediate metavolcanics. However, as they are intercalated on an outcrop scale with biotite schist, quartz-feldspar-biotite gneiss, diopside metasandstone, and marble, they were mapped as metasediments. They commonly grade into biotite schist and calcareous diopside metasandstone. Map unit 3f is common on the limbs of the Cross Lake Antiform and on the southern limb of the Clyde Forks Antiform. The rocks of map unit 3f are fine to medium grained (0.50 to 1.2 mm), weather greyish green to dark green, and are composed essentially of hornblende (20 to 40 percent), plagioclase (45 to 65 percent), and variable amounts of quartz (0 to 5 percent) and biotite (0 to 20 percent). An additional minor mineral phase is carbonate (up to 5 percent) and in one thin section scapolite was observed. Sphene, apatite, and opaque minerals are common accessory minerals. The rocks exhibit a well-recrystallized homeoblastic fabric with granoblastic to granoblastic-polygonal plagioclase and subidioblastic hornblende and biotite. Locally porphyroblastic varieties are present containing porphyroblasts or glomeroporphyroblasts of hornblende. Foliation is well defined by the subparallel orientation of hornblende and laths of biotite and less commonly by compositional layering. Map unit 3f is distinguished from the megascopically similar metawacke described above (map unit 3e) by a more pronounced foliation, simpler composition, by a more or less equigranular texture, and by a smaller proportion of biotite and quartz.

Relatively coarse-grained muscovite and muscovite-biotite±garnet schist (map unit 3g) is found in association with metasandstone, quartz feldspathic gneiss, and fine-grained biotite schist in a few locations on the southern and northern limbs and in the core of the Cross Lake Antiform. West of Antoine Lake approximately 400 m beyond the border of the area a rusty muscovite schist containing porphyroblasts of oligoclase up to 1 cm in diameter was encountered. In thin section, the schist consists of subidioblastic plagioclase, xenoblastic quartz, and elongated subparallel laths of biotite. In one thin section studied, fine slender crystals and crystal aggregates of sillimanite and poikiloblasts (up to 7 mm) of garnet were observed. Common accessory minerals are magnetite and tourmaline. A strong schistosity is marked by subparallel alignment of prismatic minerals and even of some quartz and plagioclase. Coarse-grained, pink, muscovite schist is present 1.70 km southwest of Graham Lake right along the western contact of the Addington Complex-Graham Lake facies with the siliceous clastic metasediments. Along this contact, a gradual transition from muscovite-quartz schist to muscovite-plagioclase-microcline- quartz schist to pink, muscovite granite-gneiss is observed.

Map unit 3h is confined exclusively to the metasedimentary succession in the Cross Lake Antiform. It comprises fine- to medium-grained, light green, moderately to weakly foliated calcareous diopside gneiss and metasandstone. The rocks consist of plagioclase (45 to 55 percent), calcite (10 to 15 percent), diopside (30 to 35 percent), and subordinate garnet, sphene, quartz, microcline, and epidote. Small amounts of hornblende accompany diopside in some of these rocks. They display a fine- to medium-grained homeoblastic fabric. Weak stratiform foliation defined by layers of differing mineral composition and slightly differing grain size is observed in thin section. Diopside metasandstone is commonly, but not exclusively, found along the contacts of marble with siliceous clastic metasediments. Diopside metasandstone appears to grade into carbonate-diopside gneiss (map unit 6e).

Fine-grained, pink, biotite-muscovite and muscovite metasandstone and laminated gneiss containing plagioclase as well as microcline are interlayered with white and grey plagioclase metasandstone in the southern parts of the southern limb of the Clyde Forks Antiform. Few narrow (10 to 30 cm) bands of pink metasandstone are embedded within the mafic to intermediate metavolcanics northeast of Folger.

White, off-white to light grey, lineated to foliated, medium- to coarse-grained biotite ± hornblende ± epidote ± tremolite ± diopside ± carbonate-plagioclase-quartz gneiss (map unit 3k) is a coarse-grained variant of quartzofeldspathic gneiss of map units 3a and 3h. This rock type is confined mainly to the core of the Cross Lake Antiform and is common in the southwestern part of the region.

The Lavant-Darling supracrustal succession and the eastern belt of supracrustal rocks show a general lack of the siliceous clastic metasediments. A few narrow bands of white quartzite (map unit 3d) are interlayered with metavolcanics and marbles in the northern part of the Lavant-Darling supracrustal succession. North and northeast of the village of Lammermoor in the eastern belt of supracrustal rocks a few narrow bands of light grey rusty weathering pyrite metasandstone (map unit 3b) and biotite schist (map unit 3c) are interlayered in marble.

Limy Metamudstone Mudstone is only a subordinate rock type within the map area and is present in small amounts only in the Lavant-Darling supracrustal succession and the eastern belt of supracrustal rocks. The rocks (map unit 4a) are very fine grained to aphanitic, dark grey to black, and of a massive appearance. They are comprised essentially of fine-grained calcite and biotite. They generally occur in thin beds within dolomitic marble of the Lavant-Darling supracrustal succession. The only mappable unit was delineated northeast of Spectacle Lake.

Fine-grained, medium grey to black laminated biotite-calcite schist and biotite-hornblende-calcite schist (map unit 4b) are interlayered with marble in few outcrops north and northwest of the village of Lammermoor in the northeastern part of the map area.

Felsic to Mafic Gneiss and Schist

Map unit 5 comprises rock members which are considered by the author to have been derived partly from metavolcanics, partly from older metasediments, and partly from the younger Flinton Group metasediments. This unit is confined to the western belt of supracrustal rocks and occurs interbanded and infolded with the metavolcanics to the east and north of the Cross Lake Antiform. The rocks are comprised of a wide spectrum of mineral compositions and vary from mafic, intermediate, quartzofeldspathic, feldspathic, pelitic to calcareous types. The individual members are intercalated with each other on a small scale and some of them do not show mappable lateral extensions, hence, they all were incorporated within this composite unit.

It should be emphasized that the southwestern bands of map unit 5 lie on the strike extension of the Ompah Syncline which has been documented as a structure comprised of the Flinton Group metasediments 5.5 km southwest of the map area (Smith 1958; Moore and Thompson 1972; Pauk 1982).

Map units 5a and b are represented by mafic and intermediate gneiss and schist that are compositionally similar and also spatially associated with mafic and intermediate metavolcanics of map units 1a, b, and c. In contrast to these metavolcanics, members of map units 5a and b are better foliated and recrystallized. This may indicate that they originated from less compact rocks, i.e. mafic sediments rather than the protoliths of map units 1a, b, and c.

Many of the rocks of map unit 5 exhibit several, up to three or four foliations along which the rocks may break to form cylindrical pieces that are more or less elliptical in cross section perpendicular to the long axis of the cylindrical pieces.

This type of cleavage has not been noticed anywhere within the metavolcanic succession. Finally, these rocks are highly intercalated with the metasediments. Thus, these units may represent volcanically derived metasediments rather than metavolcanics.

Map unit 5a comprises dark green to black, fine- to medium-grained mafic gneiss and schist essentially of granoblastic to granoblastic polygonal plagioclase (40 to 45 percent) and subidioblastic hornblende (55 to 60 percent). Minor mineral phases comprise quartz, carbonate, opaque minerals, apatite, scapolite, biotite, garnet, and sphene. In one of the thin sections studied, cummingtonite (15 percent) occurs in addition to hornblende. The rocks exhibit strong penetrative foliation and stratiform layering. Hornblende gneiss and schist of map unit 5a are interlayered with greenish grey to black hornblende-biotite and biotite gneiss and schist (map unit 5b). In many outcrops, alternating hornblende-rich and biotite-rich stratiform bands ranging in thickness from 10 to 100 cm are present.

Fine-to medium-grained. greenish grey to black, hornblende- biotite and biotite-quartz-plagioclase ± carbonate ± epidote gneiss and schist of map unit 5b differ from the above map unit 5a by the presence of a large proportion of biotite and quartz at the expense of hornblende and plagioclase. The above units 5a and b grade into one another both across and along strike.

Although narrow layers of biotite-quartz-feldspar gneiss and schist (map unit 5c) are present all along the extension of map unit 5 they are by far most abundant in the area near and north of La France Lake. These rocks are fine to medium grained and weather light to medium grey. They are comprised principally of variable amounts of quartz (27 to 50 percent) and plagioclase (15 to 30 percent). The major mafic mineral is biotite accounting for 15 to 25 percent of the rock. Smaller amounts of hornblende or muscovite may accompany biotite. Tourmaline is a common accessory mineral. The rocks are well foliated and exhibit homeoblastic to porphyroblastic textures. The biotite and quartz-feldspar layers define the compositional layering and biotite, muscovite, and hornblende the foliation. Garnet and large linear orientated laths of muscovite commonly form porphyroblasts. Opaque minerals make up 8 to 15 percent and in one of the three thin sections studied, i.e. in a sample from west of La France Lake, sillimanite and relict staurolite were observed. Macroscopically these rocks resemble felsic to intermediate metavolcanics; their mineral compositions, however, suggest that they are of metasedimentary origin. Whether any of these rocks belong to the Flinton Group is uncertain.

Map units 5d, e, f, g, and h described below, occur at various stratigraphic levels, predominantly within the southwestern band of map unit 5 southwest of the siding of Folger. They also occur northwest, southwest, and south of La France Lake.

Map unit 5d represents fine- to medium-grained, pinkish, medium to dark grey weathering gneiss and schist. These rocks are comprised basically of varied proportions of quartz, plagioclase, microcline, biotite, and muscovite. Northwest of Robertson Lake in a narrow band of these rocks, large linear-oriented poikiloblasts of muscovite up to 5 mm in length and a substantial amount of magnetite (15 percent) occur. Northwest of Robertson Lake they commonly display cleavage along biotite-rich, flattened elliptical cylindrical surfaces similar to some of the species of map unit 5a and b. In a thin section from east of the siding of Folger, in addition to long, linear-orientated porphyroblasts of muscovite and rotated porphyroblasts of garnet, a considerable amount of carbonate and scapolite is asso-

ciated with quartz, plagioclase, microcline, and mica. These rocks are well foliated and vary in texture from homeoblastic to heteroblastic. Porphyroblasts also may be present.

Fine- to medium-grained, buff to rusty weathering metasandstone (map unit 5e) occurs southwest of La France Lake, south of the siding of Folger, and north of the siding of Beatty. In thin section, the rocks consist of a fine-grained heteroclastic matrix of quartz, microcline, plagioclase, biotite, and tourmaline. In a few locations pyrite is also present.

Large porphyroblasts of muscovite up to 1 cm long are oriented either parallel or across the foliation planes. Subparallel trains of minute rods and granules of tourmaline occur within quartz, microcline, and muscovite. The rocks are compositionally layered and well foliated. Nonporphyroblastic and less mica-rich varieties also occur in map unit 5e.

Fine-grained muscovite and coarser grained muscovite-biotite schists (map unit 5f) are restricted to two outcrops southwest of the siding of Folger and to a few outcrops northwest and southwest of La France Lake. In thin section, fine-grained muscovite schist is comprised of a fine-grained matrix of granoblastic quartz alternating with subparallel muscovite-biotite layers. K-feldspar forms relatively large lenticular grains. Minute rods and granules of tourmaline form subparallel accumulations. Porphyroblasts of kyanite up to 5 mm in length were noted in a thin section from the southwestern part of map unit 5f.

Fine- to medium-grained pink muscovite quartzofeldspathic gneiss ± carbonate (map unit 5g) is limited to a few outcrops northeast and east of the siding of Folger. These rocks are fine to medium grained and weather pink. They contain long porphyroblasts of muscovite in a matrix of quartz, microcline, plagioclase, muscovite, biotite, and some carbonate.

Map unit 5h comprises fine- to medium-grained laminated biotite-diopside ± carbonate schist, dark green biotite-hornblende-carbonate schist, and dark green, fine-grained, chlorite-hornblende-carbonate-quartz schist. These rocks are confined to a few outcrops south and southwest of the village of Folger. Biotite-diopside schist is present in an outcrop southwest of La France Lake.

Carbonate Metasediments

Carbonate metasediments (map unit 6) occur in northeastward trending zones or in large fold structures in all three belts of supracrustal rocks. Within the map area, carbonate rocks recrystallized to medium- to coarse-grained and less commonly to fine-grained calcitic and dolomitic marbles. These marbles occur in thick beds or form narrow beds within clastic metasediments and less commonly within metavolcanics. Carbonate metasediments are subdivided primarily on the basis of their mineral composition into eight subunits. Only map unit 6k represents a textural rather than a compositional variant.

Rocks of map unit 6a are medium- to coarse-grained granoblastic calcitic marble. Colour varies from white, off-white to grey-blue with salmon pink shades being less common. In general, the marble beds are massive. Locally dark grey, phlogopite and graphite-bearing laminae and bands are present. Map unit 6a is the most widely distributed of all of the marble units. In the northwestern part of the map area, a thick succession of dominantly calcitic marble occupies the core of the Clyde Forks Antiform. Thick beds of grey and white calcitic marble dominate the upper part of the Lavant-Darling succession of supracrustal rocks. Here, marble is comparatively finer grained than in the western and eastern belts of supracrustal rocks. White, grey, and white-grey banded marble is the dominant carbonate metasediment also within the eastern belt of supracrustal rocks.

Dolomitic marble of map unit 6b is restricted to the central belt of supracrustal rocks that is the Lavant-Darling succession of supracrustal rocks. The marble is aphanitic to very fine grained, light, medium to dark grey, and commonly weathers to a reddish brown. It is mostly massive but, in places, exhibits fine laminations defined by varying shades of grey. In thin section, the dolomitic marble consists of very fine grained (0.02 to 0.1 mm) granoblastic dolomite and calcite with minor

Photo 3. *Strongly fractured dolomitic marble of the Lavant-Darling supracrustal succession contained in the Robertson Lake Shear Zone. Roadcut along Lanark County Road No. 16, approximately 800 m northeast of hamlet of Lavant.*

small grains of quartz and earthy stringers of opaque minerals. The entire unit of dolomitic marble is contained within the Robertson Lake Shear Zone. The rocks are strongly fractured and fractures are commonly filled with quartz and/or white coarser crystalline dolomite. The author attributes the fine-grained texture of this unit to kinematic recrystallization during cataclastic deformation of the central supracrustal belt, which led to a reduction of grain size of the predeformational marble.

Map unit 6c occurs commonly in the Cross Lake Antiform and comprises calcitic and dolomitic marble containing phlogopite, diopside, and tremolite and locally biotite and hornblende. These calc-silicate minerals are commonly lineated or segregated into subparallel layers to yield banded marble.

White and grey medium- to coarse-grained calcitic and dolomitic marbles containing concordant lenses, discontinuous layers, and narrow interbeds of white quartzite are assigned to map unit 6d. Reaction rims of white to greyish elongated crystals of tremolite or crystal aggregates to fibrous tremolite have been formed at marble-quartzite contacts. This map unit is prominent within a narrow zone of marble extending northeastward from the vicinity of the settlement of Wilbur toward Spectacle Lake. It also occupies the core of a narrow synform in the northwestern part of the map area. The shape and laminated texture of some of the lenses and layers of white quartzite resemble relict stromatolitic textures that were documented (Bourque 1981) in the lower metamorphic grade dolomitic marbles of the Central Metasedimentary Belt southwest of the map area.

Banded diopside-carbonate gneiss (map unit 6e) is common in the Cross Lake Antiform and commonly occurs at carbonate and siliceous clastic metasediment contacts. Banding is attributed to segregations of carbonate-calc-silicate layers and quartzofeldspathic-calc-silicate layers. Carbonate layers are usually coarse grained and comprised of calcite, diopside, and scapolite. The fine-grained quartzofeldspathic layers contain quartz, plagioclase, diopside, and less commonly horn-

Photo 4. *Quartzite bed in dolomitic marble showing fine laminated texture possibly of biogenic origin — relict stromatolites(?). In power line clearing 600 m northeast of settlement of Wilbur and 2.2 km north of the southern boundary of the map area.*

blende. With increasing amounts of quartzofeldspathic minerals and diopside, the rocks grade into diopside metasandstone (map unit 3h).

Map unit 6f comprises medium- to coarse-grained, white to light grey, i.e. rather pure dolomitic marble. Thicker beds of this pure dolomitic marble occur in an approximately 300 m wide belt of carbonate metasediments north of the siding of Beatty in the southwestern part of the region.

Calcitic and dolomitic marble containing masses of coarse-grained diopside and tremolite, and diopside skarns are grouped together in map unit 6g. Garnet, epidote, and quartz in places accompany diopside.

Map unit 6h represents a magnetite-calcite ± diopside skarn formation. A magnetite skarn deposit of economic size is present at the contact of marble with the Northbrook Batholith 480 m east of the settlement of Wilbur. A smaller deposit of magnetite-calcite-diopside skarn is located at the contact of marble with the Addington Complex-Graham Lake facies, 900 m southwest of Graham Lake. Both localities are described in detail in the section on Economic Geology.

METAMORPHOSED FELSIC INTRUSIVE ROCKS

Granodiorite-Gneiss and Trondhjemite-Gneiss

Granodiorite- and trondhjemite-gneiss have limited exposure in the southwestern part of the map area. A small northeastward trending body is located between the supracrustal rocks and the Addington Complex southwest of Caldwell Lake, and represents the northern limits of the Northbrook Batholith (Pauk 1984). The Northbrook Batholith is a large conconcordant intrusive body extending northeastward from the village of Northbrook (southwest of the map area) and the Marble Lake region for some 60 km into the southwestern part of the present map area. Outside the present region the bulk of the intrusion is comprised of white to light grey and locally pink, medium- to coarse-grained lineated to weakly foliated granodioritic

and trondhjemitic gneiss. Within the map area itself only a finer grained foliated border facies of the Northbrook Batholith occurs (map units 7a,b). The northern boundary of the Northbrook Batholith with the carbonate metasediments is lobate. The batholith intrudes these metasediments and contains inclusions of marble that host magnetite skarn deposit (Wilbur Mine).

Map unit 7a comprises a grey, medium-grained (1.0 to 1.5 mm) trondhjemitic gneiss. In thin section, the gneiss is composed of quartz (20 percent), plagioclase (65 percent), microcline (5 percent), and biotite (10 percent). Apatite, zircon, and sphene are common accessory minerals. Hornblende may also be present. The rocks are hypidioblastic gneissic. The biotitic trondhjemitic gneiss is the most widespread rock type within the northern part of the Northbrook Batholith. White, medium- to fine-grained biotite granodiorite-gneiss (map unit 7b) is restricted to a few outcrops along the boundaries of the Northbrook Batholith with the Addington Complex.

The trondhjemitic gneiss of map unit 7c is restricted to three narrow concordant lenses within the Addington Complex. The gneiss is similar to the biotite trondhjemitic gneiss of the Northbrook Batholith (map unit 7a). Its relationship to the Northbrook Batholith, however, is uncertain, and as it may be not related to this batholith at all it is shown as a separate unit on the geological map (back pocket).

Addington Complex

The Addington Complex forms a narrow northeastward trending belt which extends from the vicinity of the Town of Tweed 100 km southwest of the map area to the northeast beyond the northern limits of the map area for a total strike-length of about 120 km. The body is about 3 km wide and forms a ridge (about 2 km wide) stretching northeastward across the west-central part of the map area. West of Robertson Lake the body is subdivided by a band of supracrustal rocks into a northern and a southern branch. The subdivision might have been caused tectonically or the supracrustal rocks within the complex, namely marble and metavolcanics, may represent remnants that were more resistant to granitization than the protolith of the Addington Complex. Throughout the complex numerous narrow discontinuous layers and lenses of supracrustal rocks (map unit 5) and marble are enclosed. In the northwestern and western part of the map area, the Addington Complex forms narrow (20 to 200 m) concordant bands and lenses within the supracrustal rocks. These bands and lenses were likely produced by granitization of supracrustal rocks. Two narrow lenses of the Addington Complex are enclosed in the Lavant-Darling supracrustal succession in the north-central part of the map area. They are contained within the Robertson Lake Shear Zone and were likely separated from the main body by faulting.

In the western part of the map area, pink, fine-grained, lineated to weakly foliated granite-gneiss occupies the core of the Cross Lake Antiform. The gneiss is fairly homogeneous in composition and texture. Along its southern contact, pink granite-gneiss grades laterally across a narrow zone of potassium metasomatized rocks into siliceous clastic metasediments (map unit 3a, b).

The author therefore believes that the granitic rocks, represent granitized metasediments as does the main Addington Complex and that they possibly originated during the Addington granitization event. To indicate this relationship the term "Graham Lake Facies" of the Addington Complex is used by the author for the granitic gneiss in the Cross Lake Antiform.

In comparison to the Graham Lake facies, the Addington Complex itself is less homogeneous, better foliated, and somewhat stratified consisting of alternating layers of differing compositions and textures.

The most abundant rock-type within the Addington Complex and the Graham Lake facies is a fine- to medium-grained, pink, leucocratic lineated to weakly foliated granite-gneiss (map unit 8a). In thin section the Addington Complex rocks are composed of quartz (40 percent), microcline (40 percent), plagioclase (15 percent), and chloritized biotite (5 percent). Plagioclase and microcline form randomly oriented subidioblastic to heteroblastic grains ranging in size from 1.0 to 1.5

mm. Quartz grains are lenticular and strongly strained. Some of the larger grains of quartz and less commonly microcline are recrystallized to a fine-grained mosaic. Subparallel flakes of biotite and lenses of quartz define the lineation. A thin section from near the western border zone of the Robertson Lake Shear Zone reveals that microscopically discernible effects of mechanical deformation persist beyond the megascopically delineated boundary of the shear zone.

In thin sections from the Graham Lake facies, rocks are composed of quartz (40 percent), microcline (35 percent), plagioclase (10 percent), biotite (5 percent), and small amounts of muscovite, and subordinate amounts of sphene, hematite, zircon, and apatite. Quartz is present in two modes as small oval-shaped to nearly round little strained grains and as larger linear-oriented and commonly strained grains. Biotite, muscovite, and some of the larger grains of quartz define lineation and gneissosity of the rock.

In some areas, particularly in the Graham Lake facies rocks, large amounts of muscovite in addition to, or at the expense of, biotite are present.

Medium-grained, pink, foliated granite- and quartz monzonite-gneiss (map unit 8b) are readily distinguished from map unit 8a by better developed foliation, comparatively large grain-size (quartz in particular), and by a larger proportion of biotite and/or hornblende. The grain-size ranges from 0.7 to 1.0 mm in feldspars and 2.0 to 5.0 mm in quartz. Quartz is lenticular, orientated, and strongly strained. Apatite, sphene, and zircon are accessory minerals and the opaque minerals are either magnetite or hematite. Modal abundances based on microscopic work and on staining of three samples are quartz 25 to 30 percent, microcline 15 to 30 percent, oligoclase 30 to 40 percent, and biotite and/or hornblende 10 to 20 percent and indicate the compositional range from granite, quartz monzonite to granodiorite for these rocks.

Map unit 8c comprises fine-grained and less commonly medium-grained, pink, foliated, biotite and biotite-muscovite quartz monzonite- and granodiorite-gneiss. These well-foliated gneisses commonly form stratiform (0.30 to 1.0 m) layers within the gneiss of map unit 8a or occur along the outer borders of the Addington Complex or along the contacts with enclosed supracrustal lithologies. The proportion of mica in these rocks varies from one outcrop to another and also within a single outcrop. In thin section, the rocks display a generally heteroblastic-xenoblastic well-foliated fabric. Foliation is defined by subparallel orientation of flakes and laths of mica and stretched grains of quartz. Quartz forms lenticular, subparallel grains that are strongly strained to granulated to a fine mosaic. Modal analyses of two samples yielded a composition of quartz monzonite and granodiorite respectively.

Pink granite-, quartz monzonite-, and granodiorite-gneiss of map unit 8d is contaminated by xenoliths of mainly mafic supracrustal rocks. The xenoliths are stretched subparallel to the foliation of the host rocks. This unit 8d is limited to a few outcrops occurring mostly along the contacts of the Addington Complex with the enclosed or with the neighbouring supracrustal rocks.

All of the above described rock types of map units 8 (with the exception of map unit 8d) are commonly interlayered and two or all three members may occur within a single outcrop. The stratified character of the gneiss, the presence of conformable inclusions of the host rocks, and the gradational nature of the contacts with the host rocks suggest that the Addington Complex might have originated by granitization of pre-existing lithologies.

SYNTECTONIC MAFIC INTRUSIVE ROCKS

Lavant Gabbro Complex

The Lavant Gabbro Complex occupies most of the eastern part of the region. The intrusion extends for some 25 km southwest of the map area boundary to Oso Township and 6.5 km to the northeast beyond the northern boundary for a total length of some 45 km. In the eastern part of the map region, the body encloses large inclusions of supracrustal rocks. It extends further to the east for a total width of 14.5 km which is the widest part of the body. East of the map area along the

eastern margin of the body, the Lavant Gabbro Complex appears to form a series of sills within supracrustal rocks. The width of the Lavant Gabbro Complex decreases to the southwest and north of the map area to 6.5 km and 8 km respectively. The body trends northeastward (N30E) parallel with the regional strike of the host rocks and is bounded by the Lavant-Darling supracrustal succession to the west and by the eastern supracrustal succession to the east. Inclusions and small bodies of the Lavant Gabbro Complex occur elsewhere within the supracrustal rocks along its border zones and particularly along its eastern border zone. The complex encloses narrow bands and inclusions of marble and metavolcanics which likely represent roof pendants. The western periphery of the Lavant Gabbro Complex lies partly within the Robertson Lake Shear Zone.

The bulk of the body is structureless except at its peripheries. At the eastern periphery a weak lineation paralleling structural patterns of the enclosed supracrustal rocks is developed. The body is compositionally heterogeneous on both large and small scales. Commonly several textural and compositional varieties showing no gradational contacts occur within a single outcrop. The rocks range in composition from granodiorite, quartz diorite, diorite to gabbro. The textures vary from fine, medium, coarse to very coarse and porphyritic. The compositional and textural characteristics suggest that several subsequent intrusive pulses are responsible for the heterogeneous character of the body. The southern half of the Lavant Gabbro Complex and its eastern periphery are overall more felsic in composition comprising a larger proportion of diorite and granodiorite than gabbroic phases. The northern half of the body with the exception of its westernmost section consists of rocks of predominantly gabbroic composition. Within the present map area, the overall composition of the Lavant Gabbro Complex is mafic to rarely intermediate.

Primary rhythmic and graded layering of pyroxene cumulus occurs in a roadcut 1.2 km northwest of Black Creek Meadow (Photo 5). The layers strike 90 degrees and dip 30 degrees to the south. The primary rhythmic layering was also recorded by Carter (1981) some 1.5 km east of the map area at roadcuts of Lavant County Road 16.

A presence of several phases of gabbro and crosscutting relations of gabbroic and felsic phases indicate a complicated history of emplacement of the Lavant Gabbro Complex. Pink granite-pegmatite (map unit 9a) and white aplite (map unit 9b) form narrow dikelets and veinlets in the Lavant Gabbro Complex. They are apparently not associated with any of the felsic differentiates of the Lavant Gabbro Complex nor with the small intrusions of granitic composition (map unit 13) and probably represent late pegmatitic phases.

Granodiorite and quartz diorite (map unit 9c) form dikes and small to larger discordant bodies that cut across the mafic and intermediate members of the Lavant Gabbro Complex. Together with diorite (map unit 9d) they are dominant rock types particularly in the southern and eastern parts of the body. Their contacts with the older mafic lithologies are sharp. Granodiorite and quartz diorite are grey, weather light grey, and are commonly medium grained (1 to 3 mm) with local finer and coarser varieties. The essential minerals are oligoclase, quartz, biotite, or biotite and hornblende or biotite and muscovite. Microcline makes up from 0 to 15 percent of the rocks. Common accessory minerals are apatite, zircon, sphene, and opaque minerals. In thin sections, the rocks display an equigranular, hypidiomorphic-granular texture. Large grains of quartz show strain effects. Lineated to weakly foliated granodiorite and quartz diorite are present along the contact of the Lavant Gabbro Complex with marble northwest of the village of Lammermoor.

Map unit 9d comprises medium grey to greenish grey, commonly, medium-grained diorite. In thin section, the rocks are seen to be composed of lath-shaped to equant grains of plagioclase ranging from 2 to 3 mm in maximum dimension. Plagioclase is commonly zoned and contains numerous inclusions of muscovite, biotite, and epidote. Quartz forms small (0.5 to 1.5 mm) interstitial grains and makes up 0 to 8 percent of the rock. Randomly oriented grains of biotite account for 30 percent of the rock. Hornblende commonly is present too.

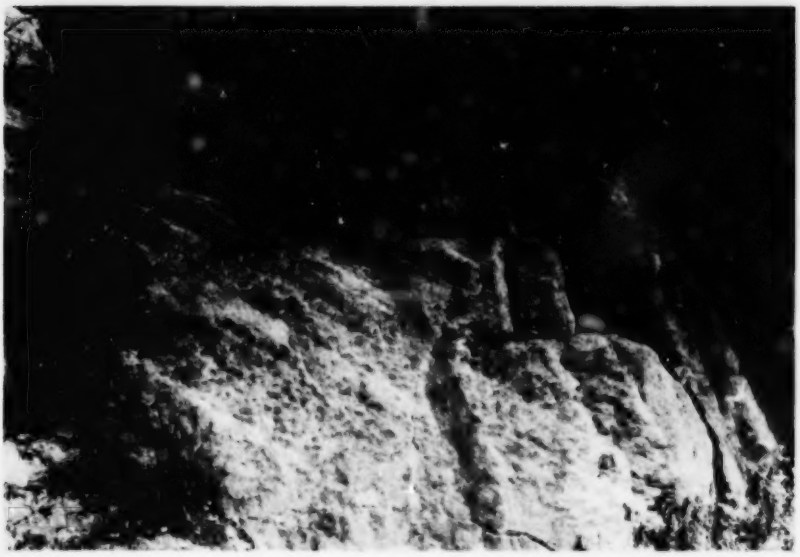

Photo 5. *Primary graded rhythmic layering in the Lavant Gabbro Complex. The only exposure found in the map area is located along Joes Lake Road, 1.2 km northwest of Black Creek Meadow.*

Fine-grained phases of gabbroic to dioritic compositions (map unit 9e) are widely distributed throughout the Lavant Gabbro Complex. The distinction between fine-grained gabbro and fine-grained diorite is difficult to make, and therefore both gabbro and diorite are grouped in the same map unit. In the field, the rocks weather dark green-grey, dark green to black and display a massive texture. In thin section, these rocks are composed of more or less equigranular subhedral to anhedral zoned plagioclase 0.2 to 0.75 mm and fine-grained subhedral grains or fine-grained aggregates of hornblende. Either biotite or relict clinopyroxene (pigeonite or augite) may also be present. Common accessory minerals are magnetite, pyrite, sphene, and apatite. Medium- to coarse-grained gabbroic rocks (map unit 9f) occur throughout the Lavant Gabbro Complex, however, they are most common in the northern half of the intrusion. The gabbroic rocks are massive and dark green to greenish black. Ophitic and subophitic gabbro appears to be lighter coloured. The rocks vary in grain-size from medium to relatively coarse and exhibit hypidiomorphic-granular subophitic and less commonly ophitic textures. In thin section, they are composed of subhedral to anhedral, lath- to tabular-shaped grains of plagioclase (An_{40-60}) and irregular grains and aggregates of hornblende. Up to 5 percent quartz and 10 percent biotite may be present. Common accessory minerals are sphene, iron oxides, and apatite.

The intensity of secondary alterations varies from place to place. Some of the hornblende grains outline the original grains of pyroxene and small relict grains of clinopyroxene were observed in one of the thin sections studied. Plagioclase is commonly altered to sericite, carbonate, scapolite, or to saussurite. Hornblende and biotite are commonly replaced by chlorite and carbonate.

Very coarse grained gabbro (map unit 9g) consists of long laths of plagioclase (0.5 to 2 cm) and long prisms (1.0 to 5 cm) and coarse-grained aggregates of hornblende. These rocks show a commonly well-developed ophitic texture. They are present together with other gabbroic phases, particularly northwest of the village of Lammermoor and south of Black Creek Meadow.

Porphyritic pyroxene and pyroxene gabbro (map unit 9h) commonly occur in the northernmost parts of the Lavant Gabbro Complex, namely to the west, south, and in the vicinity of Black Creek Meadow and north of Fleming Lake. These rocks are dark greenish black to black and weather dark bronze to rusty. In the porphyritic rocks, the grain-size of the matrix varies from fine to medium and short prismatic phenocrysts of pyroxene range from 0.5 cm to 4 cm. In some locations, lath-shaped phenocrysts of hornblende up to 6 cm in length are present instead of pyroxene. The equigranular pyroxene gabbro is fine to medium grained, massive, and dark green to black. A thin section of porphyritic gabbro revealed a fine-grained (0.5 to 0.8 mm) equigranular subophitic matrix comprised of 52 percent plagioclase, 18 percent hypersthene, 10 percent augite, 12 percent hornblende, and 8 percent iron oxide. Phenocrysts, on average 8 mm in maximum dimension, are comprised of dark brown, strongly pleochroic, prismatic hornblende. These phenocrysts are pseudomorphic after pyroxene since in places, relict grains of pyroxene are still preserved within them. Glomerocrysts comprised of smaller grains of altered clinopyroxene and hypersthene were observed in one thin section. The proportion of the matrix to phenocrysts as well as the size of phenocrysts vary. On average the phenocrysts make up 10 to 40 percent of the rock.

Primary layering defined by grading of pyroxene phenocrysts is present in a roadcut 1200 m northwest of Black Creek Meadow. In each of the subsequent layers, the grain-size of phenocrysts gradually decreases so that tops to the south can be identified.

Strongly fractured and sheared rocks of the Lavant Gabbro Complex are grouped together in map unit 9K.

FLINTON GROUP

The Flinton Group is a formally defined succession of clastic and carbonate metasediments which lie unconformably on metavolcanics and older clastic and carbonate metasediments and on large granitic intrusions (Moore and Thompson 1972, 1980). These rocks are preserved in narrow synformal structures and belts within the Central Metasedimentary Belt. The Flinton Group comprises six formations (Moore and Thompson 1980), but within the map area only three are present: Bishop Corners Formation, Myer Cave Formation, and Fernleigh Formation.

Moore and Thompson (1980) identified the lithologies within each of the above three formations as follows (listed from bottom to top):

Bishop Corners Formation	Myer Cave Formation	Fernleigh Formation
Pelitic schist	Dolomite marble	Biotite-carbonate schist
Quartzite-pebble conglomerate	Graphitic pelite	
Quartzite, quartzofeldspathic psammite	Carbonate conglomerate	
White quartzite, conglomerate	Carbonate conglomerate, pelite, marble	

The Flinton Group is characterized by both lateral and vertical facies changes (Moore and Thompson 1980).

In the present area, the Flinton Group occurs in two narrow northeastward trending approximately 700 m wide belts in the northwestern part of the map area and west of Robertson Lake respectively. The northwestern belt of Flinton Group rocks lies on a strike extension of the Fernleigh Syncline which is exposed about 10 km southwest of the map area, and which is comprised of the Flinton Group rocks (Moore and Thompson 1972, 1980; Pauk 1982). Within the map area, the synclinal form of the Flinton Group can no longer be defined and thus the name

Fernleigh belt is preferred. The above-mentioned second belt of the Flinton Group which is exposed west of Robertson Lake will be referred to as the La France Lake belt in this report. The La France Lake belt lies at approximately the same stratigraphic level with the Flinton Group metaconglomerate and migmatized metaconglomerate west of Cross Lake in Palmerston Township (Pauk 1984).

Within the map area, most all of the above-listed rock members of the Bishop Corners Formation and Myer Cave Formation are present. Further, a hornblende-biotite-carbonate ±diopside schist (map unit 12b) is included as a member of the Fernleigh Formation for its close association with the biotite-diopside schist, a high metamorphosed equivalent of the biotite-carbonate schist.

The mafic gneiss and schist (map unit 10e) included by the author as part of the Bishop Corners Formation may, in part, be equivalent to the Ore Chimney Formation which occurs below the base of the Flinton Group some 35 km southwest of the map area and is described by Moore and Thompson (1980) as dark grey or black weathering garnet-biotite ± hornblende schist and interpreted as metamorphosed regolith which formed from mafic volcanic rocks on the pre-Flinton erosional surface.

Bishop Corners Formation

Members of the Bishop Corners Formation present in the map area comprise pelitic schist (unit 10a,c), fine-grained metasandstone, and locally pyritic metasandstone (map unit 10b), quartzofeldspathic and potassic quartzofeldspathic gneiss and schist (map unit 10d), mafic metasediments (map unit 10e), and quartzite-pebble metaconglomerate (map unit 10f). The Bishop Corners Formation is present in the Fernleigh belt and is a dominant rock type also of the La France Lake belt.

Map unit 10a comprises grey to silvery grey, fine- to coarse-grained micaceous schist. In thin section, the schist displays a well-recrystallized homeoblastic and some porphyroblastic fabric. Locally, narrow, continuous to discontinuous bands showing compositional layering or lenticular foliation planes are present. These rocks are composed principally of quartz and varied proportions of muscovite and biotite, their proportion being anywhere from 0 to 100 and 100 to 0. Plagioclase or microcline are present in some of the rocks. Iron oxides may account for up to 10 percent of the schist and may be present in the form of porphyroblasts. Other common porphyroblastic minerals in this unit are garnet and oligoclase. Tourmaline is a common accessory mineral. Sillimanite is the only aluminum-silicate mineral within the map area. It forms linear, slender, prismatic crystals or crystal aggregates and together with biotite and muscovite defines a strong linear-planar foliation. Excellent, easily accessible exposures of coarse-grained mica schist are present in a roadcut of the Mississippi Snowmobile Trail (an abandoned Kingston and Pembroke Railway) about 700 m northwest of Burnt Meadow. This outcrop forms part of the only wider and more continuous band of coarse-grained mica schist within the Fernleigh belt. In other parts of the Fernleigh belt only narrow layers of finer grained mica schist are interlayered with other lithologies of the Bishop Corners Formation. Coarse-grained mica schist occurs in greater abundance in the La France Lake belt.

Map unit 10b comprises fine-grained biotite and pyrite-biotite metasandstone. These rocks are light to medium grey and commonly rusty weathered. They occur throughout the Bishop Corners Formation of the Fernleigh belt and together with the coarse-grained mica schist (map unit 10a) form a substantial part of the La France Lake belt. The rocks consist principally of plagioclase, quartz, biotite, and up to 10 percent pyrite. Plagioclase is present in greater amounts than quartz. The rocks are granoblastic and weakly foliated. The foliation appears to be along relict bedding surfaces. Narrow intercalations of fine-grained biotite schist (map unit 10c) commonly accompany this unit.

Dark grey to black to locally rusty, fine-grained biotite schist (map unit 10c) commonly forms narrow layers and intercalates within the above-described biotite metasandstones (map unit 10b). In thin section, the schist displays an equigranular lepidoblastic texture and strong linear-planar foliation. The rocks are composed of

quartz (40 percent), plagioclase (15 percent), biotite (30 percent), opaque minerals (10 percent), garnet (2 percent), muscovite (2 percent), and a trace of tourmaline. Locally, garnet and/or muscovite are present.

A variety of rocks embraced in map unit 10d include quartzofeldspathic and calcareous quartzofeldspathic gneiss, potassic quartzofeldspathic gneiss and metasandstone, and calcareous potassic quartzofeldspathic gneiss. Quartzofeldspathic gneiss weathers light to medium grey to greenish grey. It is fine to medium grained and commonly comprised of alternating bands of differing compositions and textures. Biotite-quartz-plagioclase bands alternate with hornblende-plagioclase-opaque minerals and quartz bands. Minor mineral phases are epidote, muscovite, and apatite. Bands of carbonate, pistachio green bands of epidote, and lighter green bands of diopside appear in addition to quartzofeldspathic bands in calcareous quartzofeldspathic gneisses. Locally, porphyroblastic hornblende or garnet are present.

Potassic quartzofeldspathic gneiss and metasandstone weather pinkish grey or pink. They are compositionally similar consisting basically of quartz, plagioclase, microcline, biotite, and muscovite. However, they display distinct textures which make them unique.

Potassic metasandstone (map unit 10d) is fine grained and displays fine stratiform laminations. The individual laminae are light grey, light greenish grey, and pink in colour. Grey laminae are comprised of a fine-grained mosaic of quartz; pink laminae consist of granoblastic microcline and quartz; light greenish grey laminae carry granoblastic plagioclase, quartz, and small granules of epidote. Small flakes of chloritized biotite and muscovite are aligned along the original bedding planes. This map unit is not common and is present only in the Fernleigh belt. It is found as a narrow lens within map unit 5 and also forms a few outcrops together with fine-grained muscovite schist (map unit 10a) 1 km northwest of the settlement of Folger. The rocks of this unit contain small disseminated specks of chalcopyrite and malachite (up to a combined 1 percent).

Pink quartzofeldspathic gneiss (map unit 10d) is medium to fine grained and weathers light pinkish grey. These gneisses exhibit good foliation defined by thin (0.5 to 1 mm) silvery micaceous layers and alternating 1 to 2.5 cm thick layers of quartzofeldspathic composition. In thin section, the quartzofeldspathic layers are comprised of a fine-grained homeoblastic matrix of granoblastic to granoblastic polygonal quartz, plagioclase, microcline, and small flakes of muscovite and biotite. The rock characteristically contains large (0.5 to 1.5 cm) randomly oriented porphyroblasts of muscovite. Small needles of sillimanite are enclosed in some of the muscovite porphyroblasts. Tourmaline and apatite are common accessory minerals. These gneisses are commonly associated with medium- to fine-grained, light greyish pink, muscovite ± biotite schist (map unit 10a) and in places they grade into them. This map unit occurs particularly in the southern part of the Fernleigh belt.

Pink potassic quartzofeldspathic gneiss is distinguished from the above greyish pink gneiss by the presence of up to 1.5 cm long linear-oriented porphyroblasts of muscovite and by overall weaker foliation. The rocks are comprised of heteroblastic, fine- and medium-grained matrix of quartz, microcline, oligoclase, muscovite, and biotite. The opaque minerals, carbonate, and apatite are present in accessory amounts. Some species may contain up to 10 percent carbonate. These rocks are confined to the La France Lake belt and are exposed in a narrow band approximately 1700 m northeast of the hamlet of Lavant Station. This map unit strongly resembles lineated K-feldspar-bearing quartzofeldspathic gneiss of map unit 5g which is exposed nearly symmetrically on the opposite side of the Cross Lake Antiform about 300 to 400 m east and northeast of the siding of Folger.

Mafic gneiss and schist and carbonate-bearing mafic gneiss and schists (map unit 10e) originated likely from volcanically derived sandstone and wacke. These rocks are commonly fine to medium grained and weather dark green to dark greyish green. Commonly, fine to coarse, dark to light laminations and banding are present. The rocks of map unit 10e are comprised of a variety of mafic, felsic, calc-silicate, and carbonate minerals that include hornblende, biotite, quartz,

plagioclase, microcline, scapolite, epidote, and carbonate. Common accessory minerals are opaque minerals, sphene, tourmaline, and apatite. All of these minerals may occur within a single specimen. One of the thin section samples revealed the presence of poorly cross-hatched potassium feldspar exhibiting a small (40 degrees) angle of the optic axis which is characteristic of high-temperature anorthoclase. This map unit is common within the Fernleigh belt. Within the La France Lake belt it is confined to narrow bands along parts of its western margin, where the Flinton Group overlies the metavolcanics.

Myer Cave Formation

The lithologies of the Myer Cave Formation within the map area are marble and dolomitic marble (map unit 11a) and graphitic-pyritic schist (map unit 11b). The Myer Cave Formation forms narrow bands and lenses (50 m) within the Fernleigh, and less commonly, the La France Lake belts.

Marble and dolomitic marble (map unit 11a) are medium to coarse grained and vary in colour from white to buff, to light grey and rarely pink. A white and grey banded variety of marble is only present locally. Stratiform foliation is marked by a variation in colour of the beds of marble and by the presence of narrow interlayers (10 to 50 cm) of biotite and hornblende-biotite schist. The marble and dolomitic marble are generally fairly pure, consisting of granoblastic calcite and calcite and dolomite respectively, but locally phlogopite, actinolite, and tremolite may be present. West of Burnt Meadow, a narrow lens of fine-grained aphanitic marble is present. The marble consists of small (0.5 to 1 cm) randomly oriented ovoids which are lined by a dark, aphanitic, graphitic substance. This type of texture was likely produced by brecciation.

Fine-grained, dark grey to black graphite-pyrite schist (map unit 11b) is restricted to one outcrop along the southwestern margin of the Fernleigh belt, just east of a large meander in Sunday Creek.

Fernleigh Formation

Within the map area, the Fernleigh Formation is comprised of biotite-diopside±carbonate±hornblende schist (map unit 12a) and subordinate hornblende-biotite-carbonate±diopside schist (map unit 12b).

The biotite-diopside schist (map unit 12e) is a very distinct unit consisting principally of rhythmically bedded dark brown biotitic and light green calc-siliceous stratiform bands. The individual bands are from 0.5 to 10 cm thick with biotite bands being generally thinner. In thin section, the biotite-diopside schist is comprised of fine-grained (0.2 to 0.4 mm) biotite-rich layers carrying biotite, quartz, plagioclase, carbonate, and minor diopside and tourmaline (in this decreasing order of abundance). Coarser grained (0.5 to 1 mm) diopside-rich layers are comprised of diopside, plagioclase, and quartz (in decreasing order of abundance). In the Fernleigh belt, the biotite-diopside schist forms a 6 km long concordant band with an average width of 150 m. Excellent exposures of this unit are present along the Mississippi Snowmobile trail (i.e. the abandoned Kingston and Pembroke Railway) about 600 m west of Burnt Meadow. A few small isolated layers of biotite-diopside schist are present in the southwestern part of the Fernleigh belt and also within the La France Lake belt.

Narrow layers of hornblende-diopside-carbonate schist (map unit 12b) accompany the biotite-diopside schist in the northern part of the Fernleigh belt. These rocks are generally medium grained and dark green in colour. They exhibit strong stratiform foliation which is defined by diopside-, hornblende-, and carbonate-rich layers. Long prismatic grains of hornblende are aligned parallel to the schistosity of some of the rocks. Locally, biotite is also present.

LATE TECTONIC FELSIC INTRUSIVE ROCKS

Granite and Granite-Gneiss

Granite and granite-gneiss (map unit 13) occur as single outcrops or in a group of outcrops and as small bodies with a maximum radius of 500 m scattered throughout the Lavant Gabbro Complex and show crosscutting relations with their gabbro host. Their relation to each other is uncertain; they may be associated with larger late tectonic felsic intrusive rocks which intrude the Lavant Gabbro Complex to the southwest of the present map area (Pauk 1984).

Map unit 13a is represented by medium-grained pink, leucocratic, biotite granite. In thin section, the granite is comprised of quartz (35 to 40 percent), microcline (40 to 45 percent), oligoclase (10 to 15 percent), and biotite (5 to 10 percent). In some of the granite, muscovite accompanies biotite. The average grain-size of felsic minerals is approximately 1.5 mm and grains of mica are generally smaller. The rock is massive, in thin section hypidiomorphic-granular. Most of the small granite bodies in the Lavant Gabbro Complex belong to unit 13a.

Medium-grained, pink, biotite granite (map unit 13b) is limited to one outcrop in the northeastern part of the map area. It intrudes the border zone of the Lavant Gabbro Complex and like the gabbro displays a weak linear fabric. Pink, weakly lineated, biotite granite (map unit 13b) is compositionally equivalent to map unit 13a.

Biotite granite-gneiss of map unit 13c is distinguished in the field from the above-described units 13a and b by its relatively coarser grained fabric (2.0 to 4.0 mm) and by a darker, reddish pink colour. The gneiss displays a weak lineation defined by aggregates of biotite, muscovite, and epidote. It is composed of approximately 35 percent quartz, 35 percent microcline, 20 percent plagioclase, and 8 percent of combined biotite, muscovite, and epidote. The quartz is strained and partly recrystallized to granoblastic quartz. This map unit 13c is confined to a small body along the northern boundary in the north-central part of the map area. Larger exposures of this rock are present north of the map area. On Geological Map No. 1956-4 of the Clarendon-Dalhousie-Darling area, the granite-gneiss described here is shown as "Darling type granite" (Smith 1958; Peach 1958).

Pegmatite

The last stage of plutonic activity in the map area is represented by pegmatitic rocks (map unit 14). These rocks showing no evidence of recrystallization and regional deformation were emplaced after the culmination of regional metamorphism and accompanying deformation. The pegmatites are granitic in composition and intrude essentially all of the above rock units. The pegmatite dikes and sills display sharp contacts with the country rocks and cut across the foliation of the host rock or intrude parallel to the foliation of the host rock.

The pegmatites were grouped on the basis of colour and mode of occurrence into the following map units: pink pegmatite dikes and sills (map units 14a and b) and white pegmatite dikes and sills (map units 14c and d). Map unit 14e represents strongly deformed phases of pegmatite outcrops within the Robertson Lake Shear Zone.

The essential felsic minerals of pink to flesh coloured pegmatite are microcline-perthite, quartz, and small amounts of albite. White pegmatites are composed either of albite and quartz or white microcline, quartz, and small amounts of albite. Biotite is the major mafic constituent and some pegmatites carry hornblende and magnetite.

Pink and white pegmatite dikes (map units 14a, c) commonly intrude the Lavant Gabbro Complex. Most of the dikes are lenticular to irregular in shape and vary greatly in width (5 cm to 500 m) and traceable length (1 m to 1 km). Numerous large (up to 0.5 km wide and 1 km long) pink and white pegmatite dikes are concentrated particularly in the vicinity of the settlement of Poland. Weak scintillometer anomalies were recorded by the geological field party in some of the

pegmatites in this area. Some small white and pink pegmatite dikes intrude supracrustal rocks and the Addington Complex.

Pink and particularly white pegmatite sills (map units 14b,d) intrude foliated lithologies throughout the map area. Pink pegmatite sills are generally less common and are confined mainly to the Northbrook Batholith and to a lesser extent to the Addington Complex and supracrustal rocks. White pegmatite sills are conformably intruded along foliation planes of metasediments, particularly in the southwestern parts of the region. Here they form large bodies up to approximately 150 m wide and are continuous along strike for some 300 to 400 m. Uranium mineralization is associated with some of the pegmatites occurring in the southwestern parts of the map area. Some white pegmatite sills are present also within the Addington Complex but rarely within the Flinton Group.

PHANEROZOIC

CENOZOIC

Quaternary

Pleistocene and Recent Unconsolidated deposits of sand and gravel and till have been deposited during the Pleistocene epoch in the form of glacial, glaciofluvial, and glaciolacustrine sediments. They form a thin and discontinuous cover over much of the map area. Locally however thicker accumulations of sand and gravel are found in the valleys, on the flanks of hills, and in morainic areas.

The western part of the region, from Antoine Lake in the south to Nelson Lakes in the north, is blanketed by gravel, sand, and silt that may have been part of an area of glacial outwash. Similar terrain is found in the vicinity of the village of Lammermoor in the northeastern part of the map area.

The terrain depression of the Robertson Lake Shear Zone is occupied by a cover of glaciofluvial sediments. These deposits form the northern extension of a prominent esker system which has been traced by E.P. Henderson (1973) southwestward from Snow Road Station (a village south of the map area) for a length of some 80 km.

Local concentrations of sand and gravel have been worked for their gravel potential in the above regions.

The Recent deposits in the map area are organic swamps and alluvial deposits. The majority of the swamps are located either in the fault and fracture zones or in low areas which parallel the foliation of the bedrock. The first type of swamp is generally developed in the Lavant Gabbro and the Addington Complexes. These swamps are commonly dendritic in shape and generally water filled. The second type of swamp is commonly narrow and long, paralleling the regional structural trends. The Recent alluvial deposits are associated with these swamps and include minor stream sediments.

Metamorphism

The supracrustal rocks of the western belt have been subjected to upper almandine-amphibolite facies regional metamorphism as indicated by the presence of sillimanite in pelitic schist. Sillimanite is also present in the southern and northern parts of the area. From just north of the area, i.e. near the village of Clyde Forks about 800 m northeast of Nicholson Lake, Rivers (1976) reported sillimanite-almandine subfacies rocks.

Within the Lavant-Darling supracrustal succession a narrow belt of metavolcanics exhibits retrograde greenschist facies mineral assemblages: albite-actinolite-chlorite, albite-hornblende-chlorite (Carter 1981), epidote-albite-chlorite, and albite-chlorite-carbonate. The retrograde metamorphism occurring along the Robertson Lake Shear Zone is accompanied by a reduction in grain size of the rocks, strong fracturing, and shearing. Compared to the western belt of supracrustal rocks, the eastern belt, in general, displays less deformation and metamorphic differentiation, which is demonstrated by the preservation of relict primary structures and textures and by the lack of metamorphic segregations. The mafic metavolcanics carry the mineral assemblages hornblende-biotite-plagioclase and hornblende-diopside-plagioclase ($An_{>30}$) characteristic of the almandine-amphibolite facies. In general, the bulk of the Lavant Gabbro Complex does not show pronounced textural or compositional changes, except for retrograde alteration of pyroxene to hornblende and plagioclase to carbonate sericite or saussurite.

Structural Geology

Structurally, the map area can be divided by the Robertson Lake Shear Zone into a highly deformed and metamorphosed western structural zone and somewhat less deformed and less metamorphosed eastern structural zone. The structural contrast between these two zones, however, is not readily observable within the Lavant area because in the eastern part of the region intrusive rocks predominate that are more resistant to deformation.

FOLDS

The complex structural pattern of the western part of the area can be attributed to at least two major periods of deformation. The first phase produced isoclinal folds which display northeastward striking stratiform foliations. The second phase of deformation produced northeastward striking large-scale open-fold structures, namely, the Clyde Forks Antiform and Synform (Rivers 1976) in the northwest and the Cross Lake Antiform (Smith 1958; Rivers 1976) in the southwest. The general fold pattern displays a series of tight, mostly poorly defined, D1 structures spaced between the open D2 fold structures.

All major first and second deformational phase structures trend northeastward (N30 to 50E). Axial plane foliations have moderate to shallow dips (30 to 70 degrees) predominantly to the south with deviations around the fold hinges. Shallow fold plunges (10 to 30 degrees) to the northeastward are indicated by quartz and hornblende roddings in the western part of the region.

FAULTS AND JOINTS

The Robertson Lake Shear Zone is a dominant structural element of the area. It forms a prominent topographic low that passes north-northeastward through the central part of the map area. The shear zone extends further to the south (Pauk 1984) and to the southwest for a total length of some 80 km (Wolff 1979, 1981). Within the present area, the width of the shear zone (400 m to 1.5 km) and the intensity of deformation increases from the south to the north. The shear zone strikes N10 to 20E and dips 60 to 80 degrees east. It appears to be a normal dip-slip fault as indicated by slickensides. The shear zone contains mylonitized metavolcanics, carbonate and minor clastic metasediments, parts of the Lavant Gabbro Complex and the Addington Complex. The rocks in the shear zone are strongly chloritized, carbonatized, pyritized, epidotized, silicified, sheared, and fractured. Carbonate metasediments display intense fracturing and in places, brecciation. The fracturing in the shear zone is multidirectional, however, the most prominent fractures appear to be those trending N40W, N85E, and N10W. In the vicinity of Spectacle Lake, the shear zone has been laterally displaced along a southwestward (N45E) trending fault.

Faults are commonly accompanied by jointing in the rocks in the vicinity of the faults. The joints in the Addington Complex strike northwestward (N70 to 80W and N20 to 40W) with essentially vertical dips. A third, less prominent, system of joints strikes N20E and dips 45 to 70 degrees west. In general, the Lavant Gabbro Complex is poorly jointed.

Economic Geology

INTRODUCTION

Numbers in parentheses following a property name denotes location on the map in the back pocket.

The Lavant area contains a variety of metallic deposits and occurrences. Only one significant producer, the iron-producing Wilbur Mine, operated in the area around the turn of the century.

Considerable mineral exploration was conducted at the Cu-Ag-Sb-Hg-Ba Clyde Forks (2) deposit in the northwestern part of the region. The exploration work on the deposit was intensified and extended into a larger area after the presence of mercury was discovered in 1967.

Seven small Cu-An-Sb-Ag deposits contained within the Lavant-Darling supracrustal succession and within the Robertson Lake Shear Zone were intermittently and sporadically investigated since 1938. The names of all the deposits listed in this report were adopted from a report by Carter *et al.* (1980).

METALLIC MINERALIZATION

COPPER-ANTIMONY-GOLD-SILVER

Lavant-Darling Deposits

Seven small stratabound deposits of copper mineralization in association with other metals are situated in the central part of the map area. They all occur within the Lavant-Darling succession of metavolcanics and carbonate metasediments, and are all contained within the Robertson Lake Shear Zone. North of the map area, three similar deposits are present within the same stratigraphic unit (Carter 1981). These 10 deposits, occurring at approximately the same stratigraphic level and above or intercalated with the metavolcanics (Carter 1981), are distributed over a strike-length of about 22 km. The Lavant-Darling deposits, as they were called by Carter (1981), are polymetallic and in addition to copper carry various metals in various proportions, particularly antimony, gold, silver, and less commonly mercury. The deposits located within the map area are underlain by a sequence of intercalated dolomitic and calcitic marble. The mineralization is contained within small lenses, pods, layers, and veinlets of quartz and less commonly coarse-grained white dolomite hosted by dark grey fine-grained dolomitic marble.

Mineralization consists of varied amounts of chalcopyrite, bornite, tetrahedrite, and pyrite. Malachite and rarely azurite form coatings on weathered surfaces. Relative proportions of the above minerals vary from one deposit to another. Bornite commonly forms large grains (up to 3 cm in diameter). Chalcopyrite forms either disseminated grains or occurs in large clusters (up to 2 cm). Tetrahedrite forms small disseminated grains and stringers and pyrite generally occurs as small, disseminated grains. The sulphides and sulphosalts are generally erratically distributed within the zones which vary considerably in width and length. Carter (1981) reported that zinc and silver are associated with tetrahedrite and gold is associated with both pyrite and tetrahedrite. Characteristics of the Lavant-Darling Cu-Sb-Au-Ag deposits occurring within the map area are summarized in Table 3 and variations in content of Cu, Sb, Au, Ag and Hg for these deposits are presented in Table 4.

As illustrated in Table 3, metal contents of the Lavant-Darling deposits vary considerably; e.g. the Robertson Gold (9) deposit contains only a negligible amount of copper; the Joes Lake (3) deposit carries an appreciable amount of mercury. It should be emphasized, that the comparisons of metallic contents of the deposits are based on a limited number of analyses (1 to 4 per deposit). Also the analyzed samples may not be representative of all the individual deposits.

Origin of the Lavant-Darling Deposits According to Carter (1981), syngenetic stratiform layers of disseminated to massive sulphides, principally pyrite, were deposited in a subaqueous carbonate depositional environment during or immediately after the waning phases of subalkaline volcanism. Subsequently, local remobilization of mineralization into dolomite, dolomite-quartz, and quartz lenses,

TABLE 3. SUMMARY OF THE CHARACTERISTICS OF THE LAVANT-DARLING CU-SB-AU-AG DEPOSITS. LISTED FROM THE NORTH TO THE SOUTH. METALS IN BRACKETS OCCUR ONLY IN SUBORDINATE TO TRACE AMOUNTS (MODIFIED FROM CARTER, COLVINE, AND MEYN 1980; CARTER 1981).

Deposit	Nature of Mineralization	Type of Mineralization	Metal Content
Joes Lake (3)	layers, pods, and lenses of white dolomite in fine-grained dark grey dolomitic marble	blebs, streaks of tetrahedrite, chalcopyrite disseminated pyrite, secondary malachite	Cu, Sb, Au, Ag, (Zn, Bi, Hg, As)
Lavant Creek (5)	network of narrow quartz in dolomitic marble	disseminated fine-grained chalcopyrite, secondary malachite, azurite, dendritic pyrolusite	Cu (Sb, Au)
Nelson Lakes (8)	pods of quartz hosted by fine-grained dolomitic marble	scattered coarse grains (up to 2 cm) of chalcopyrite	Cu, (Sb, Bi, Hg)
Begin, J. (1)	quartz-rich brecciated zone in aphanitic dolomitic marble	disseminated coarse-grained chalcopyrite, less common bornite and tetrahedrite, pyrite secondary malachite, azurite	Cu, Ag (Sb, Au, Bi)
Lavant (4)	network of narrow quartz veinlets in dolomitic marble	sparse grains of tetrahedrite, bornite, pyrite, secondary malachite	Cu, Sb, Au (Ag, Zn)
Lynx Canada (7)	stratabound quartz vein hosted by dolomitic marble	coarse-grained bornite, chalcopyrite; secondary malachite; quartz crystals in vugs	Cu, (Au, Sb, Ag)
Robertson Gold (9)	network of quartz veinlets and pods hosted by dolomitic marble near contact with sheared pyritized gabbro	disseminated pyrite and pyrrhotite	Au (Smith 1958)

TABLE 4. AVERAGE COPPER, ANTIMONY, GOLD, AND SILVER CONTENTS OF THE LAVANT-DARLING DEPOSITS IN THE LAVANT AREA.

Deposit	Cu (Percent)	Sb (ppm)	Au (ppb)	Ag (ppm)	Hg (ppb)	No. of analyses
Joes Lake (3)	0.911	2 575	6 137	34.7	930	4
Lavant Creek (5)	0.95	27.8	212	2	17.5	4
Nelson Lakes (8)	0.66	34.8	6.6	<2	<20	3
Begin (1)	1.56	1 483	156	53.5	404	5
Lavant (4)	2.58	13 000	2 200	2	13.3	1
Lynx-Canada (7)	1.77	26.2	45	13.75	N.A.*	4
Robertson Gold Deposit (9)	10 ppm	1.7	13 333	N.A.*	N.A.*	3

Notes:
The average content of metals is based (with few exceptions) on analyses of mineralized and well-mineralized samples reported by Carter, Colvine, and Meyn (1980).

Robertson Gold Deposit: 3 mineralized samples were collected by the author and analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto.

Lavant Creek Deposit: 1 of the samples was collected by the author and analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto.

Copper is reported in percent unless otherwise indicated.

*not analyzed.

layers, and veins took place as a result of regional metamorphism. The sulphides and gangue minerals were probably transported by and precipitated from retrograde metamorphic fluids. Carter and Colvine (1979) classified the Lavant-Darling deposits as early epigenetic, stratabound vein deposits.

All of the Lavant-Darling Cu-Sb-Au-Ag deposits located within the map area are contained within the Robertson Lake Shear Zone; the shears, fractures, and dislocations provided the channelways for the circulation of the solutions and also the space for their deposition.

Significant polymetallic mineralization is present at the Clyde Forks deposit in the northwestern part of the map area. Mineralization consists principally of chalcopyrite and tetrahedrite in association with barite. The mineralized zone forms a stratiform marble-hosted layer within a succession of marble and intercalated clastic metasediments. In addition to copper, economically interesting amounts of mercury, silver, and antimony are present within the mineralized zone. According to Nikols (1972), the deposit is probably syngenetic. The mineralogy, concordant nature, and limited stratigraphic thickness of the deposit indicate deposition from thermal springs, which discharged near the sea floor in a thick limy mud which was undergoing diagenesis. Carter, Colvine, and Meyn (1980) classified the deposit as stratiform, carbonate-hosted. Two narrow layers of laminated muscovite metasandstone of the Flinton Group (map unit 10d) containing small scattered

grains of chalcopyrite and coatings of malachite were located by field party personnel 900 m and 1100 m respectively northwest of the siding of Folger. A grab sample from this stratigraphic unit collected by field party personnel and analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto yielded 204 ppm copper and a trace of gold.

GOLD

Gold is associated with copper-antimony-silver mineralization in the Lavant-Darling deposits situated within the central part of the map area. The available analytical data indicate that the most promising of the above deposits are the Robertson Gold Deposit, the Joes Lake Deposit, and possibly the Lavant Deposit. Additional information about the Lavant-Darling deposits is provided in the section, "Copper-Antimony-Gold-Silver".

IRON

Iron oxides, most commonly in the form of magnetite, occur as accessory minerals in many rock types. However, significant concentrations of magnetite, which in past were extracted, occur at the Wilbur Mine. Magnetite is contained within stratabound carbonate-hosted skarn that formed along a contact of marble and granodiorite. The magnetite ore, which presently is well exposed only in the ore dumps, consists of fine-grained massive magnetite accompanied by chlorite, epidote, and carbonate. According to the Iron Ore Committee (Ontario 1924), magnetite mineralization forms a "series of detached ore bodies" just within the granitic intrusion along its contact with marble. From the locations of the old workings, it is apparent that the orebodies are spread over a strike-length of about 830 m.

A stratabound skarn-hosted magnetite deposit of smaller dimension is exposed in two pits 800 m southwest of Graham Lake. It is contained within a contact zone of marble with granite-gneiss.

Subeconomic, minor magnetite occurs commonly in gabbro-diorite rocks of the Lavant Gabbro Complex. Peach (1958) described a number of occurrences of magnetite within this complex and particularly along its northern contact to the north of the map area. At a few locations within the map area, the amounts of magnetite exceeded the accessory amount, e.g. northwest of Lammermoor and southeast of Connors Lake. However, no such higher concentrations as described by Peach (1958) were encountered in this geological setting within the present area.

MERCURY

Mercury is present in association with copper-silver-antimony and barite at the Clyde Forks deposit in the northwestern part of the region. The mineralized zone forms a concordant layer within the marble, averaging 1.6 m in thickness, 91 m in length, and extending down-dip at least 152 m (Carter, Colvine, and Meyn 1980). The mineralization consists principally of tetrahedrite, chalcopyrite, pyrite, and barite. The principal mercury-bearing minerals are mercurian tetrahedrite and cinnabar (Nikols 1972). The average grade of mercury in the above-mentioned mineralized zone was reported to be 0.68 lbs. mercury per ton (Mineral Deposit Records, Ontario Geological Survey, Toronto).

Less significant amounts of mercury occur in association with copper-antimony-gold-silver at two of the Lavant-Darling Cu-Sb-An-Ag deposits, i.e at the Joes Lake (3) and Begin deposits (1). At the Joes Lake deposit, an average content of mercury from four analyzed grab samples and 2.5 feet of an assayed drill core amounted to 702 ppb Hg (Carter, Colvine, and Meyn 1980; Assessment Files Research Office, Ontario Geological Survey, Toronto). At the Begin deposit, five grab samples from the mineralized zone averaged 404 ppb mercury (Carter, Colvine, and Meyn 1980). At both of the above deposits, mercury mineralization is probably associated with tetrahedrite.

SILVER

Significant concentrations of silver are present at the Clyde Forks deposit in the northwestern part of the map area. Less significant amounts of silver occur in the Lavant-Darling Cu-Sb-An-Ag deposits within the central part of the region. For a description of the above deposits, the reader is referred to the section on "Copper-Antimony-Gold-Silver".

SULPHIDE MINERALIZATION

Widely distributed throughout the map area are numerous small occurrences of pyrite, in places accompanied by small amounts of pyrrhotite and chalcopyrite. Pyrite forms narrow and discontinuous stratiform bands and disseminations in older siliceous clastic metasediments and metavolcanics and in biotite metasandstones and schists of the Flinton Group.

Pyrite is commonly present as an accessory mineral in the Lavant Gabbro Complex and the Addington Complex.

Most prominent pyrite mineralization occurs throughout the Robertson Lake Shear Zone. Pyrite is commonly found in seams, stringers, and disseminations within those parts of the metavolcanics, carbonate metasediments, the Lavant Gabbro Complex, and the Addington Complex which were affected by intense shearing. Pyrite grains and rusty coatings commonly accompany networks of quartz and carbonate veinlets filling the fractures in the country rocks. Also, at several locations, significant base-metal mineralization is associated with the fracture-filling veinlets. A detailed description of the above-mentioned base-metal mineralization is provided in the "Copper-Antimony-Gold-Silver" section.

URANIUM AND THORIUM

Appreciable scintillometer anomalies (3 to 5 times background) were recorded by field party personnel in some of the clastic metasediment-hosted pegmatite sills in the vicinity of Antoine Lake and Twentysix Lake in the southwestern part of the map area.

A few pegmatite dikes and sills yielding above background scintillometer readings are present in the area of Umpherston Meadow northwest of Robertson Lake and in the vicinity of the settlement of Poland.

NONMETALLIC MINERALIZATION

Good quality pure white, medium-grained dolomitic marble occurs in a northeastward trending band 500 m north of the siding of Beatty.

Sand and gravel deposits are being worked by local operators in the Lammermoor and Lavant area.

DESCRIPTION OF PROPERTIES AND OCCURRENCES

The history of exploration given in this report does not extend beyond August 1982 and is limited to company reports available to the public and to data obtained by field party personnel during the 1982 mapping program.

BEGIN (1)

The deposit is situated on the grounds of the Lavant waste (local garbage) disposal site and is easily accessible by Lanark County Road 16, eastward from the settlement of Lavant on Robertson Lake.

The mineralized zone occurs within a thick horizon of intercalated dolomitic and calcitic marble of the Lavant-Darling supracrustal succession, that is bounded by the Lavant Gabbro Complex to the east and by metavolcanics and the Addington Complex to the west. The deposit is located within the Robertson Lake Shear Zone and is near its eastern edge. The marble strikes northeastward and dips moderately, 45 degrees to the southeast. The sulphide mineralization is contained

within a conformable silicified breccia zone hosted by very fine grained, light to dark grey, well-layered dolomitic marble. The mineralized zone is about 1 m wide and is exposed about 17 m along strike (N60E) in a trench. Mineralization consists of abundant, erratically disseminated clusters of chalcopyrite up to 2 to 3 cm in diameter, less abundant tetrahedrite and bornite, and fine-grained, disseminated pyrite. Secondary malachite is common. The main sulphide-bearing zone shows a gradational contact with the marble host. Some small vugs lined with crystals of quartz are present in some of the narrow quartz veinlets, which cut across the brecciated silicified marble and into the adjacent marble.

A trench, 3 m wide, about 2 m deep, and 17 m long, was excavated sometime in the past and no record of this prospecting work is available. In 1973, the deposit was sampled by J. Begin of Ottawa (Source Mineral Deposit Records, Ontario Geological Survey, Toronto). In 1975, Lynx-Canada Explorations Limited conducted geological and geochemical surveys to the southeast and to the north of the Begin deposit excluding the Begin deposit itself. The description of the Begin deposit is given in a report by Carter, Colvine, and Meyn (1980) and the results of five analyzed grab samples from the mineralized zone mentioned in their report are listed in Table 5.

CLYDE FORKS (2)

The property is located in the northwestern part of the map area, along the northern boundary (Figure 2). The property which in the 1960s constituted some 89 claims presently comprises nine claims which are held on lease by Carndesson Mines Limited. The property is accessible by a forest access road which extends west from the Mississippi Snowmobile Trail (abandoned Kingston and Pembroke Railway) to Lavant Long Lake (out of map area). A junction of the Mississippi Snowmobile Trail with the forest access road is located 280 m north of the map area. The road log is provided in the report by Carter, Colvine, and Meyn (1980, p.36). The property is underlain by marble intercalated with narrow interbeds of biotite-plagioclase-quartz gneiss and biotite-hornblende-plagioclase gneiss. White, coarse-grained, more or less concordant, pegmatite bodies occur to the south and to the north of the main workings. Regionally, the rocks on the property form part of the closure of the northeastward trending (N52E) and northeastward plunging Clyde Forks Antiform. Small-scale folds, which are probably related to drag folding within a major structure, trend N55E and plunge 20NE, and their axial surfaces dip 40 degrees southeast. The mineralized zone forms a conformable layer within medium-grained white to pink marble, and, as documented by drillholes, it averages 1.70 m in thickness, 91 m in length, and has a down-dip extension of at least 152 m. Mineralization seen in the pit, the adit, and the adjacent ore dumps consists of tetrahedrite, chalcopyrite, pyrite, barite, and an abundance of secondary malachite and azurite. The presence of stibnite, arsenopyrite, chalcostibite, getchellite, mercurian tetrahedrite, and cinnabar was noted in polished thin sections by Nikols (1972). A 1 m thick layer of massive barite with abundant disseminated tetrahedrite is exposed in a 3 m deep test pit. Within the adit, barite-sulphide-sulphosalt mineralization occurs in conformable nodular segregations and disseminations along stratiform foliations within marble. Generally, the mineralization is erratically distributed within the mineralized layer.

Initially, the deposit was investigated for its barite mineralization. First recorded development consisted of about 50 m of surface stripping and test-pitting which were carried out by T.B. Caldwell in 1919 to 1920. H.S. Spence (1922) described a hard, semitranslucent variety of barite in contrast to a softer, opaque, white paleozoic variety and reported a presence of considerable sulphide mineralization exposed on the bottom of the test pit. A small sample of barite analyzed by Mines Branch Laboratories (Spence 1922) yielded 96.25 percent barium sulphate, 0.52 percent copper, 1.80 oz silver/ton, and showed a presence of antimony. Four flotation tests produced a clean white concentrate containing 97.75 percent barium sulphate. Recovery of copper and silver was reported to be approximately 80 percent and 50 percent respectively (Spence 1922).

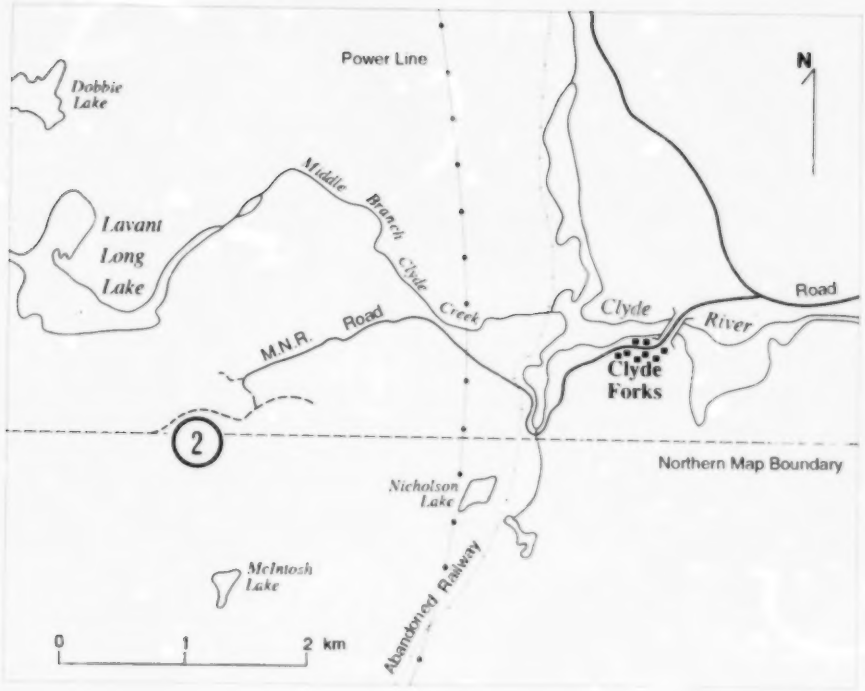

Figure 2. *Location and access to the Clyde Forks deposit.*

TABLE 5. ANALYSES OF SELECTED SAMPLES FROM THE BEGIN DEPOSIT (1) (in PPM unless indicated otherwise).

Sample Number	Cu-7-4	78TC211	78TC212	78TC213	78TC215
Cu	1.99%	2.45%	50	1.28%	2.10%
Sb	0.72%	91.5	74.4	25.4	25.0
Au	720 ppb	20 ppb	10 ppb	10 ppb	20 ppb
Ag	235	3	3	3	18
Zn	-	64	29	16	16
Pb	-	-	-	-	-
Ba	-	-	-	-	-
Bi	190	120	-	-	-
Hg	2.0	<20 ppb	-	-	-
As	-	12	-	-	-

Carter, Colvine, and Meyn (1980, p.35, Table 15)

TABLE 6. SUMMARY OF EXPLORATION ACTIVITIES BETWEEN 1957 AND 1970, CLYDE FORKS DEPOSIT (2).

Company or Individual	Years	Type of Exploration Work
J. Szitowski	1957	2 diamond-drill holes (106 m)
Lanark Silver Mines Ltd	1958-1960	4 diamond-drill holes (258 m), magnetic and self-potential surveys; soil sampling
West Branch Explorations and Mining Company Ltd.	1964; 1967-1969	Regional soil and stream geochemical surveys; metallurgical testing; excavation of 30 m long adit in the hillside with 2 short crosscuts, surface shipping, 30 diamond-drill holes totalling 1133 m
Carndesson Mines Ltd	1969-1970	Geological and geochemical surveys, metallurgical testing; 24 diamond-drill holes totalling 1784 m

Sources:
Assessment Files Research Office, Ontario Geological Survey, Toronto
Source Mineral Deposit Records, Ontario Geological Survey, Toronto

Between 1957 and 1970 a comprehensive mineral exploration program consisting of geological and geochemical surveys, diamond-drilling, and analytical testing was conducted on the property by several companies and individuals and a large number of geological and analytical data were obtained. A summary of the exploration work conducted on the property between 1957 and 1970 and available analytical data from the property are listed in Tables 6 and 7 respectively.

In 1969, D.C. Sullivan completed an evaluation of the property for Carndesson Mines Limited, based primarily on a study of exploration data up to that date. He reported that the second phase of a diamond-drilling program of the West Branch Explorations and Mining Company Limited was successful in delineating a base and precious metal zone of considerable importance. The copper-silver-mercury-antimony mineralization was reported to occur in a fold or drag fold which plunges to the northeast at approximately 35 to 40 degrees. The mineralized zone has been outlined in part by diamond-drilling for a distance down dip of 600 feet and along strike for approximately 400 feet. During the second exploration phase, the presence of mercury in mercurian tetrahedrite was detected. The discovery of mercury gave West Branch Explorations and Mining Company Limited an incentive to further examine the mineralized zone and an adit (98 feet long) was driven into the hill east of the main barite pit. Sullivan reported that diamond-drilling has outlined approximately 60,000 tons of copper-antimony-mercury sulphides with promising silver values. The results of a geochemical stream survey conducted by West Branch Exploration and Mining Company Limited indicated anomalous concentrations of mercury and copper over an area 4.8 by 8 km, and a subsequent reconnaissance soil survey delineated at least three anomalous zones within a 1.2 km radius of the adit. Further investigation in the form of re-drilling and analytical testing of the previously outlined main mineralized zone was recommended (Source Mineral Deposits Records, Ontario Geological Survey, Toronto). Subsequently, Carndesson Mines Limited commenced a diamond-drilling program in late 1969 (Assessment Files Research Office, Ontario Geological Survey, Toronto). A total of 15 diamond-drill holes were sunk to test the main sulphide zone. Thirteen holes intercepted the main mineralized zone along a strike-length of 133 m for a distance of 200 m down dip. Results of the above 13 holes showed an average width of 1.70 m grading 7.50 lbs antimony per ton, 13.40 lbs copper per ton, 0.68 lbs mercury per ton, and 1.32 oz silver per ton (The Northern Miner 1970). Reserves on this orebody are estimated to be 60,000 tons grading 0.67 percent Cu;

TABLE 7. SUMMARY OF ANALYTICAL DATA, CLYDE FORKS DEPOSIT (2).

Company or Individual	Reported Metal Content	Source
Lanark Silver Mines Ltd.	range of assayed drill core samples: nil to 1.46 oz silver/ton nil to 0.67 percent copper channel samples across barite layers in main pit averaged: 0.71 oz silver/ton grab samples of the mineralized zone:	Ontario Securities Division, March 1960
	Ag oz/ton: 3.54 — Au oz/ton: trace — Cu %: 1.54 — Sb %: 3.22	
	average metal concentrations of some hundred soil samples collected over some of the major self-potential anomalies: 5-100 ppm Cu; 100-200 ppm Zn; 25 to 200 ppm; less than 1 ppm silver	Assessment Files Research Office, Ontario Geological Survey, Toronto
Carndesson Mines Ltd.	2 analyzed samples of tetrahedrite yielded:	
	Cu %: 37.1 — Hg %: 3.87 — Sb %: 21.29 — Ag %: 0.37 Cu %: 35.0 — Hg %: - — Sb %: 17.0 — Ag %: 89.7 oz/ton	Report by D.W. Sullivan for Carndesson Mines Limited (Source Mineral Deposit Records, Ontario Geological Survey, Toronto).
	Picked and analyzed fragments of chalcopyrite, tetrahedrite, and calcite yielded 0.7%, 0.5%, and 0.2% mercury respectively	
	Analyzed split core samples from the drillholes by the West Branch Explorations and Mining Co. Ltd. showed the following metal concentrations:	
	Cu %: 0.61 — Hg %: 0.06 — Ag oz/ton: 1.2 — Sb %: 0.24 (over 5 feet of core) Cu %: 1.07 — Hg %: 0.03 — Ag oz/ton: 2.0 — Sb %: 0.42 (over 6.5 feet of core) Cu %: 1.2 — Hg %: 0.133 — Ag oz/ton: 2.98 — Sb %: 0.72 (over 4.0 feet of core)	
	Channel samples collected from crosscut and main drift in adit yielded:	
	Cu %: 0.72 — Hg %: 0.012 — Ag oz/ton: 1.24 — Sb %: 0.33 (over 2 ft. of crosscut) Cu %: - — Hg %: - — Ag oz/ton: trace — Sb %: 0.02 (over 1 ft. of crosscut) Cu %: 0.24 — Hg %: 0.020 — Ag oz/ton: 0.39 — Sb %: 0.10 (over 6.4 ft. of crosscut) Cu %: 0.95 — Hg %: 0.044 — Ag oz/ton: 1.44 — Sb %: 0.30 (over 5 ft. of drift) Cu %: 0.76 — Hg %: 0.026 — Ag oz/ton: 0.74 — Sb %: 0.18 (over 5 ft. of drift)	

TABLE 7. CONTINUED.

Company or Individual	Reported Metal Content	Source
	13 diamond-drill holes by Carndesson Mines Ltd. situated in the main mineralized zone gave the following assay results:	The Northern Miner, April 2/70, Volume 56, Number 2

Hole No.	Width ft.	Copper lbs./ton	Antimony lbs./ton	Mercury lbs./ton	Silver oz./ton
1	9.0	7.6	15.0	0.70	2.11
3	1.7	26.4	12.4	0.50	2.28
4	4.0	30.0	13.4	0.90	1.97
5	5.0	19.0	10.6	0.60	1.60
6	2.5	5.4	7.6	0.40	1.70
7	2.5	9.0	4.2	0.80	0.45
10	13.7	13.7	2.8	0.30	0.40
12	4.0	8.0	3.6	0.66	1.10
13	5.5	12.1	3.9	0.50	0.75
14	4.2	9.5	4.4	0.40	1.00
16	6.0	13.2	7.4	0.75	1.40
19	6.2	15.8	7.6	1.00	2.00
20	3.0	10.2	8.8	2.10	2.00

C. Nikols	Emission spectrograph analyses of sulphide, wall-rock marble, barren marble, and pegmatite for content of 14 minor and trace elements demonstrated preferential enrichment of the hanging-wall in Sb, Cu, Ag, and Mn. Footwall marble showed a less sympathetic relationship with the sulphide and nearby pegmatite sills showed no relation to mineralization	Nikols (1972)

0.37 percent Sb; 0.03 percent Hg, and 1.32 oz/ton Ag (Source Mineral Deposit Records, Ontario Geological Survey, Toronto).

JOES LAKE (3)

The deposit is located in the north-central part of the map area at the northern border. A gravel road, extending southeast from Joes Lake (outside the area, to the north), crosses two claims of the property. The deposit lies within the Lavant-Darling supracrustal succession and is underlain by a thick succession of intercalated dolomitic and calcitic marble and minor metavolcanics. The Joes Lake deposit is contained within the eastern edge of the Robertson Lake Shear Zone. The mineralization is exposed in a roadcut and in an overgrown pit 50 m southwest of the roadcut (Carter, Coivine, and Meyn 1980). The host rock is well layered, very fine grained, dark grey dolomitic marble, containing layers and lenses of white dolomite. The marble containing a few siliceous layers exposed in the roadcut is intensely sheared and fractured and, in places, brecciated. Many fractures are occupied by quartz and carbonate veinlets. Mineralization consists of fine-grained disseminated pyrite and coatings of secondary malachite. The author did not visit the test pit and the following description of the mineralization is taken mainly from Carter (1981). The mineralization consists of tetrahedrite, chalcopyrite, and minor pyrite with secondary malachite and azurite. The sulphides and sulphosalts are erratically disseminated within pods, layers, and lenses of white dolomite in marble. The main mineralized zone consists of an irregular, poorly defined layer of white dolomite, 15 cm wide, containing up to 10 percent disseminated sulphides. In 1978, Selco Mining Corporation Limited sunk two diamond-drill holes in the vicinity

TABLE 8. ANALYSES OF SELECTED SAMPLES OF MINERALIZATION, JOES LAKE DEPOSIT (3) (in ppm unless otherwise indicated).

Sample Number	78TC146	78TC226	78TC227	78TC228
Ag	42	3	68	26
Au	4800 ppb	250 ppb	15100 ppb	4400 ppb
Cu	6160	740	2.46%	4960
Sb	2500	360	5800	1640
Zn	470	68	1640	300
Pb	<10	-	-	-
Hg	-	120 ppb	3600 ppb	-
Bi	-	35.0	360	-
As	-	78	2300	-

*From Carter, Colvine, and Meyn (1980, p.39, Table 18)

of an old test pit at a distance of about 40 m (hole No. JL-1) and 320 m (hole No. JL-3) southwest of the gravel road. The third hole was put down further to the southwest at a distance of about 1300 m from the gravel road. Hole JL-3 intercepted dolomitic marble with irregular bands of massive pyrite between 126 and 130 feet, a semi-massive pyrite band between 152 and 153 feet, and a few stringers of pyrite between 155 and 160 feet. The corresponding analyzed core sections contained 0.01 oz Au/ton over 4 feet, 0.02 oz Au/ton over 2 feet, and 0.01 oz Au/ton over 5 feet (Carter, Colvine, and Meyn 1980, p.39). Hole JL-1 intercepted a band of massive pyrite at a depth of 55.5 to 57.0 feet, containing 5280 ppm Cu, 5160 ppb Au, 1919 ppm Sb, and 475 ppb Hg. Hole JL-2 intercepted only minor mineralization (Assessment Files Research Office, Ontario Geological Survey, Toronto). The analysis results of four grab samples from the mineralized zone reported by Carter, Colvine, and Meyn (1980) are summarized in Table 8.

LAVANT (4)

This small showing is located in a power line clearing at a distance of 820 m east of Robertson Lake via the power line. The mineralization is exposed in an outcrop of dolomitic marble on the south side of the power line clearing. The underlying rocks are comprised of fine-grained grey dolomitic marble and intercalated calcitic marble. The marble horizon is bounded by the Lavant Gabbro Complex to the east and by metavolcanics and the Addington Complex to the west. The showing is located within the Robertson Lake Shear Zone. The marble host rock is crisscrossed by a network of narrow quartz veinlets which are sparsely mineralized with small grains of tetrahedrite, minor bornite, pyrite, and secondary malachite. Carter, Colvine, and Meyn (1980) reported that the mineralized zone is about 6 m wide and over 10 m long.

In 1975, Lynx-Canada Explorations Limited conducted geological mapping on one claim in this area, which included the Lavant showing. The result of the geological survey was reported as being inconclusive (Assessment Files Research Office, Ontario Geological Survey, Toronto). Carter, Colvine, and Meyn (1980, p.40) reported contents of 85 ppm Ag, 2200 ppb Au, 2.58 percent Cu, 1.3 percent Sb, 1270 ppm Zn, and 51 ppm Pb from a grab sample of the mineralized veinlet. However, the above values were not considered by the above authors to be representative of the mineralized zone.

LAVANT CREEK (5)

The Lavant Creek deposit is located on the east side of a steep ridge 400 m west of the pond on Lavant Creek. It is accessible by a recently constructed lumber road. The access road to the property is illustrated in Figure 3.

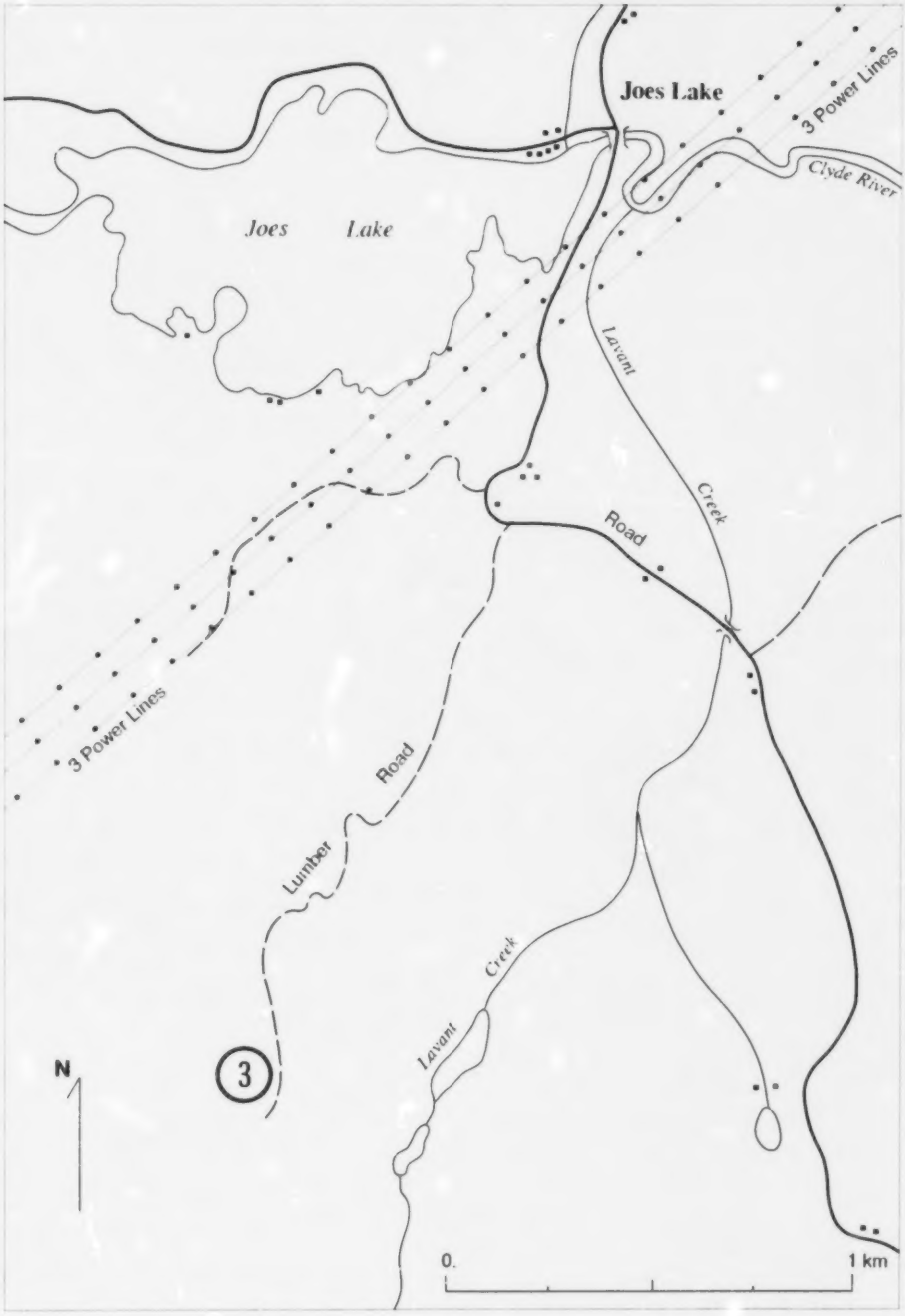

Figure 3. *Location and access to the Lavant Creek deposit.*

The property is underlain by metavolcanics intercalated with narrow layers of dolomitic marble and quartzite. A narrow layer of granite-gneiss of the Addington Complex is exposed on top of the ridge, north of the main mineralized zone, and a small body of the Lavant Gabbro Complex intrudes the metavolcanics in the eastern part of the property. All of the rock units on the property are sheared and fractured. They all lie within the Robertson Shear Zone which in this region has a lateral extension of some 1.70 km.

Mineralization is contained within a narrow (about 20 m) concordant lens of off-white dolomitic marble.

The host marble is cut by a network of narrow quartz veinlets and stringers which are mineralized with fine grains and stringers of chalcopyrite and disseminated pyrite. The amount of sulphides gradually decreases in the quartzite footwall and further into the more distant metavolcanics. The main mineralized zone occurs along the bottom part of the hillside and it has been cleaned of debris by surface stripping. The whole outcrop is stained by green and blue malachite-azurite coatings. Four shallow pits spreading over a length of about 60 m are located at the bottom of the hill. It is not known to the author when and by whom these pits were excavated. They are now filled with debris. The largest pit, nearly circular in shape, about 8 m in diameter and 3 m deep exposes dark grey aphanitic quartzite. The quartzite is brecciated and mineralized with chalcopyrite, particularly near the contact with the main mineralized lens of marble. The dimensions of the mineralized zone are estimated to be 1 to 3 m in width and 15 to 30 m in length (Carter, Colvine, and Meyn 1980, p.41). In 1957, nine diamond-drill holes totalling 500 m were completed on the two claims of the property by H.F. Taylor. Only minor mineralization was observed in the drill core. (Assessment Files Research Office, Ontario Geological Survey, Toronto).

In 1975, Lynx-Canada Explorations Limited conducted geological and geochemical surveys on 13 claims of the property. Soil samples were collected along a major stream and along a few of its tributaries and the collected samples were analyzed for Cu, Zn, Ag, Bi, and As. Results of the above surveys were reported as inconclusive (Assessment Files Research Office, Ontario Geological Survey, Toronto). Presently, the property comprises 6 claims which are registered in the name of H.G. Pharaoh.

A grab sample of well-mineralized dolomitic marble collected by the author and analyzed by Geoscience Laboratories, Ontario Geological Survey, Toronto returned 0.76 percent copper, 1220 ppb gold, and traces of bismuth, antimony, and mercury. A grab sample collected by the author from the underlying metavolcanics and containing disseminated chalcopyrite and pyrite yielded 166 ppm copper and 205 ppb gold on an analysis by Geoscience Laboratories, Ontario Geological Survey, Toronto. Carter, Colvine, and Meyn (1980) reported copper concentrations of 1.90 percent, 0.90 percent, and 0.20 percent along with insignificant values of gold, bismuth, and mercury, which were returned from three selected samples from the mineralized zone.

LAVANT STATION (6)

The Lavant Station iron deposit is located 900 m southwest of Graham Lake, 20 m north of a gravel road extending west and southwest from Lavant Station. It lies along the southern discordant contact of pink granite-gneiss (considered by the author to be an equivalent of the Addington Complex) with a succession of intercalated clastic siliceous metasediments, calc-siliceous clastic metasediments, and carbonaceous metasediments. Other rocks exposed in the area are white and pink pegmatite sills. Lenses of magnetite occur within a lensoid layer of marble which is partly enclosed by granite-gneiss and within the marble inclusions enclosed by granite-gneiss. Marble is medium grained, white and massive to white and grey banded. Marble layers adjacent to granite-gneiss contain characteristic skarn assemblages comprised of epidote, hornblende, quartz, diopside, garnet, and vesuvianite. The mineralization consists of narrow discontinuous lenses of massive magnetite. The magnetite zone is estimated to be about 3 m wide and of unknown length (Carter, Colvine, and Meyn 1980).

Ingall (1901) reported that a small pit was excavated on a magnetite showing on lots 27 and 28, concession XI. The present survey located one flooded pit measuring 7 by 10 m and one flooded trench about 5 m wide, 2 to 3 m deep, and about 13 m long. The pit is located 20 m north of a gravel road and the trench is 90 m farther north. A small ore dump is located in a power line clearing about halfway between the two workings.

An analyzed sample of massive magnetite contained 60.8 percent Fe, 20.8 percent FeO, 0.10 percent TiO_2, 0.04 percent P_2O_5, 0.04 percent S, and 0.05 percent V (Carter, Colvine, and Meyn 1980).

LYNX-CANADA (7)

The property consisting of one claim is located 800 m east of the northeastern tip of Robertson Lake, 150 m south of a high voltage power line and 220 m south of a gravel road. The rocks on the property are comprised of intercalated dolomitic and calcitic marble and form part of the Lavant-Darling supracrustal succession. The Robertson Lake Shear zone crosses the property. The host rock of the mineralized zone is a very fine grained, dark grey dolomitic marble. The sulphide mineralization is contained within a northeastward (N40E) striking quartz vein that is about 0.5 m wide and over 3 m long. Clusters of bornite coated and lined by secondary malachite are by far the most common sulphide. Together with chalcopyrite and minor tetrahedrite, they are erratically distributed within the vein. The vein contains numerous cavities lined with white to reddish stained crystals of quartz.

In 1975, Lynx-Canada Explorations Limited carried out detailed geological mapping on one claim, which included also the above described Lavant showing (Assessment Files Research Office, Ontario Geological Survey, Toronto).

Carter, Colvine, and Meyn (1980, p.42) reported metal concentrations from four mineralized samples of the quartz vein. Contents of copper ranged from 1,740 ppm to 3.88 percent and silver from 0.09 oz/ton to 0.96 oz/ton. All four samples also returned low values of antimony and gold.

NELSON LAKES (8)

The property is located in a low lying area between Spectacle Lake and Nelson Lakes and is accessible by a farm road extending from Robertson Lake north to Pigeon Lake. The property is underlain by a succession of metavolcanics and carbonate metasediments, and bounded by the Addington Complex to the west and by the Lavant Gabbro Complex to the east. The rock units strike approximately north-south and dip moderately (45 degrees) to the east.

The host rock of the mineralization is very fine grained, dark grey, bronze-weathered dolomitic marble, cut by a network of narrow (0.5 to 2 cm), fracture-filling quartz veinlets. A small pit measuring 1.8 by 2.5 m and 3 m deep is located on the property, but there is no mineralization exposed in the pit. Samples containing patches of secondary malachite can be seen in the adjacent ore dump. Carter (1981) states that the mineralization consists of erratically scattered coarse grains of chalcopyrite up to 1 to 2 cm in diameter contained within a small pod of coarse-grained dolomite and quartz. The mineralized pod has been completely removed by development work.

In the 1950s, the property consisted of 11 claims which were held by Lanark Silver Mines Limited. Three diamond-drill holes totalling 226 m were reported to have been drilled in the northeastern part of the property. Low values of gold, silver, and copper from the analyzed parts of the drill core were reported (Ontario Securities Commission, March 7, 1960, see Table 9).

In 1975, Lynx-Canada Explorations Limited conducted geological and geochemical surveys along with some rock sampling on most of the 11 claims of the property. Geochemical soil sampling was carried out on most of the streams and samples were analyzed for Cu, Zn, Ag, As, and Bi. The results of the exploration were reported as inconclusive (Assessment Files Research Office, Ontario Geological Survey, Toronto) and the claims were subsequently dropped.

TABLE 9. SUMMARY OF REPORTED ANALYSES OF GRAB SAMPLES, NELSON LAKES DEPOSIT (8).

Sample Location	Ag oz/ton	Cu %	Au oz/ton	Pb %	Sb %
test pit, lot 9, concession VII	3.0	5.60	-		
test pit, lot 8, concession VII	-	1.09	-		
lot 6, concession VIII	1.85	7.40	trace	0.02	0.12
lot 12, concession IV	6.90	2.65			
lot 4, concession IX			0.11		

Source: Ontario Securities Commission, March 7, 1960

The analysis results of four selected samples from the Nelson Lakes deposit as reported by Carter, Colvine, and Meyn (1980) are summarized in Table 10.

ROBERTSON GOLD DEPOSIT (9)

The deposit is situated 165 m east of the southern tip of Robertson Lake and 650 m west from the intersection of the Lavant-Dalhousie Lake gravel road with a farm road.

It is contained within a narrow, generally north-southward striking unit of dolomitic marble and bordered by the Lavant Gabbro Complex to the east and by the Addington Complex to the west. Small bodies of Lavant Gabbro Complex commonly intrude the marble horizon. Structurally, the area lies within the Robertson Lake Shear Zone and this is reflected by strong shearing, fracturing, and alteration of all of the rocks.

The deposit is exposed by 13 closely spaced northwestward trending trenches for a distance of approximately 500 m across the strike. These surface workings and about 1000 m of diamond-drilling were performed by the Consolidated Mining and Smelting Company in 1938 and 1944 (Smith 1958). Gold (0.11 oz/ton over 1.86 m) was reported by Smith (1958). Carter, Colvine, and Meyn (1980) reported 50 ppb Au in one assayed sample.

The trenches are, on average, 16 m long and filled with heavy debris. The rock outcrop is poor in the area and also in the trenches. Rocks exposed in the trenches are comprised of massive aphanitic to fine-grained, creamy to dark grey, rusty dolomitic marble, fine- to medium-grained sheared gabbro, and grey to rusty, mafic, siliceous gneiss and schist. Some of the mafic and siliceous schist may be of volcanic origin. The marble is cut by a network of veinlets and irregular pods of fine-grained white quartz. The mineralization consists of fine grains of pyrite and pyrrhotite disseminated in quartz and country rock. Analysis results from grab samples collected by the author in trenches and analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto are presented in Table 11.

WILBUR MINE (10)

The deposit is situated in the southwestern part of the map area, about 400 m northeast, across a wide swamp, from the settlement of Wilbur. It is accessible by a forest access road extending south along Little Antoine Creek; the last 1.4 km are along a private road.

The Wilbur iron mine was developed and operated under a lease by the Kingston and Pembroke Mining Company before 1900 (Ingall 1901). The early development was the largest one and consisted of eight workings. Location of the old workings is illustrated in Figure 4. Working No.1 is a shallow water-filled pit;

TABLE 10. ANALYSES OF SELECTED ROCK SAMPLES FROM NELSON DEPOSIT (8) (in ppm unless otherwise indicated).

Description of sample	Cu	Sb	Au	Ag	Zn	Hg	Bi	As	Pb
well-mineralized marble from the workings	1.10%	<100	-		-	<40 ppb	30	-	-
unmineralized quartz vein	64	1.9	<10 ppb	<3	14		-	-	22
mineralized sample from the workings	6120	3.9	<10 ppb	<3	119	20 ppb	18.8	2	-
mineralized sample from the workings	2860	0.5	<10 ppb	<3	11	-	-	-	-

Carter, Colvine, and Meyn (1980, p.43, table 22)

TABLE 11. ANAYLSES OF SELECTED SAMPLES OF MINERALIZATION, ROBERTSON GOLD DEPOSIT (9) (in ppm unless otherwise indicated).

Sample Number	L-5004-82	L-5009-82	L-5011-82
Au	1 600 ppb	0.32 oz/ton (13.5)	0.59 oz/ton (24.9)
Cu	14	8	8
Pb	N.A.*	<10	N.A.*
Zn	N.A.*	29	N.A.*
Mn	N.A.*	1280	N.A.*
Ba	N.A.*	770	N.A.*
As	580	38	78
Sb	-	1.0	2.4
Hg	N.A.*	30 ppb	-
Bi	-	0.7	2.2

Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.
Sample L-5004-82 is mineralized siliceous gneiss
Sample L-5009-82 is mineralized dolomitic marble
Sample L-5011-82 is rusty siliceous schist
*Not analyzed

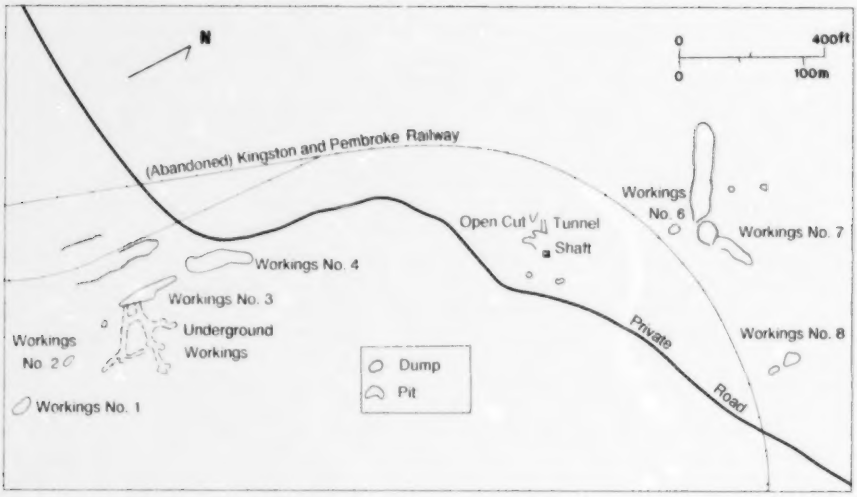

Figure 4. *Workings of Wilbur iron deposit (Ingall 1901).*

No.2 consists of two shallow pits; No.3 is a flooded pit about 20 by 30 m with two inclines at the eastern end; No.4 is an open cut extending some 60 m along the hillside; No.5 is a small tunnel and a couple of shallow test pits; No.6 is a pit; No.7 is a large flooded pit, said to be about 100 m deep; No.8 is a couple of water-filled pits (Ingall 1901). According to Ingall (1901), some 125,000 tons of high-grade ore were shipped from the mine and an unspecified number of diamond-drill holes were completed prior to 1900. Diamond-drill holes varied in depth from 60 to 75 feet and the ore was intersected in a range between 5 to 15 feet (Ingall 1901). About 1900 after the leases lapsed, some development was made by the owner, Wm. Caldwell (De Kalb 1901).

Between 1907 to 1908 the mine was operated by Wilbur Iron Ore Company. E.T. Corkill (1908) reports that daily shipments of 150 to 200 tons of ore were made to The Algoma Steel Corporation in Sault Ste. Marie, for a total of 21,892 tons during this period (Lindeman and Bolton 1917). New development consisted of an inclined (27 degree) shaft, that was put down to a depth of 226 feet south-southeast from the bottom of the No. 3 pit. A limited amount of underground development was completed (Corkill 1908).

After being closed for a couple of years, the mine was reopened in 1910 by the Hawthorne Silver and Iron Mines Company; no shipments were recorded in this period (Lindeman and Bolton 1917). In 1911, the Exploration Syndicate of America operated the mine for a short time (Corkill 1912). Experimental tests on 10 tons of the iron ore from the Wilbur Mine and on 5 tons of the material from the waste dump at the Wilbur Mine were made by the Ore Dressing and Metallurgical Laboratories of the Mines Branch, Department of Mines, Ottawa. The testing included a cobbing test, a magnetic separation test, and analyses of crude concentrates and tailings. The tests revealed that a high-grade iron concentrate could be made from both the run-of-mine and the lower grade waste ore by fairly coarsely grinding them and sintering the concentrate (Timm 1925).

The deposit is underlain by intercalated calcitic and dolomitic marble in the western part of the property and by a concordant intrusion of granodiorite-gneiss (considered by the author to be a part of the Northbrook Batholith) in the eastern part of the property. The boundaries between marble and granodiorite are relatively straight, except for the north end of the intrusion where granodiorite-gneiss forms lobes that project into the marble. The marble in turn forms small embayments within granodiorite (as crudely illustrated on the accompanying map, back pocket).

It is along this northern irregular contact of marble and granodiorite-gneiss that the magnetite-bearing skarn formation has formed. Massive magnetite occurs in several isolated skarn-hosted orebodies spread over a strike-length of 800 m. Other rocks on the property comprise pegmatite dikes and sills and inclusions of metavolcanics within granodiorite. The marble is a white medium-grained rock, composed of calcite, dolomite, and less abundant tremolite and phlogopite. Magnetite mineralization is accompanied by chlorite, actinolite, and carbonate.

The rock formations strike generally northeastward and dip shallowly (20 to 40 degrees) to the east.

The reported grade of a carload of iron ore from the Wilbur deposit averaged 56.69 percent Fe, 6.20 percent SiO_2, 0.01 percent P, 0.01 percent S, 2.56 percent Al_2O_3, 2.00 percent CaO, 6.84 percent MgO, and 0.20 percent MnO. It was indicated, however, that the average iron content of the shipments was much lower (Ontario 1924).

A sample of iron ore contained 48.9 percent Fe, 21.20 percent FeO, 0.19 percent TiO_2, 0.02 percent P_2O_5, 0.01 percent S, and 0.01 percent V (Carter, Colvine, and Meyn 1980). According to Carter, Colvine, and Meyn (1980) the mineralization probably is genetically related to the granitic intrusion and resulted from contact metasomatic reactions with marble. The observations made by the author support this interpretation.

Suggestions for Future Mineral Exploration

A thick succession of marble and interlayered clastic metasediments is host to stratiform Cu-Sb-Ag-Hg mineralization on the Clyde Forks deposit. Anomalous concentrations of copper and mercury were delineated by a geochemical soil survey conducted by West Branch Explorations and Mining Company Limited within a half mile radius of the existing deposit suggesting that there is good potential for additional mineralization within this stratigraphic unit and geological structure.

Seven small deposits of Cu-Sb-Au-Ag mineralization occur within the Lavant-Darling supracrustal succession. They are all hosted by a dolomitic marble unit that is stratigraphically above or intercalated with the mafic metavolcanics. The deposits are all contained within the Robertson Lake Shear Zone. During the present geological mapping, field party personnel encountered numerous barren and rusty narrow quartz and carbonate veinlets and networks of quartz and carbonate veinlets which occupy countless fractures and shear planes in deformed rocks. This favourable geological and structural environment persists within the map area over a strike-length of 13.8 km. Further prospecting of this zone by geological mapping, geochemical soil sampling, and rock sampling may be rewarding. Of eight known deposits, only two were tested to shallow depths by a limited number of diamond-drill holes. Additional examination of known deposits and prospecting to depth is worth consideration.

The potential exists for good quality dolomitic marble and decorative marble.

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